



Missouri Department of Natural Resources
Water Protection Program
Public Drinking Water Branch

OWNERS AND OPERATORS HANDBOOK FOR SMALL COMMUNITY PUBLIC WATER SYSTEMS



This handbook is intended to help owners, operators and managers of small community water systems (subdivisions, mobile home parks, etc) understand state and federal laws and regulations that apply to their water system. Owners and operators should read the handbook to be aware of their obligations. If anything in the book is unclear, please call your local Missouri Department of Natural Resources' regional office.

The handbook is divided into two main parts. The first part is an overview of the regulatory requirements. The second part is a list of commonly asked questions with brief answers and a list of commonly made mistakes. Many of the commonly asked questions are answered in the overview.

PWS ID # MO- _____

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OWNERS and OPERATORS HANDBOOK

SMALL COMMUNITY WATER SYSTEMS

This handbook is a basic outline of information to help small community water systems meet regulatory requirements. The most important thing in this handbook is to call your local Department of Natural Resources regional office or Public Drinking Water Branch if you have any questions. The number for your local regional office can be found with the map of the department regions on the back page. The telephone number for the Department of Natural Resources' Public Drinking Water Branch is 573-751-5331; the fax number is 573 751-3110. The Public Drinking Water Branch website is www.dnr.mo.gov/env/wpp/dw-index.htm

SECTION 1 – General regulatory requirements

- A. State and federal laws require water systems that serve water to the public meet certain standards. A public water system is defined as any system that supplies water to at least 15 service connections or regularly serves an average of at least 25 individuals daily at least 60 days out of the year. This is done to protect the public from waterborne illnesses. A community public water system is one that supplies water to at least 15 service connections or regularly serves an average of at least 25 of the same individuals daily on a year-round basis.
- B. The most important of these requirements is sample the water. Normally, a sample for bacteria is required every month the system serves water to the public. If your system has more than one well and separate distribution systems, you may have to collect more than one sample each month. If a sample tests positive for bacteria, the system will be required to take more samples. Public water systems will be notified by telephone and mail of sample results and the need to take more than the one sample each month. Failure to follow instructions may result in violations of state and federal regulations.
- C. Public water systems will, throughout the year, receive water sampling kits with containers that are different from the monthly bacteria sample bottles. These are for analysis of various regulated chemicals in addition to the monthly bacteriological sample. These containers will have instructions included. Do not delay taking these samples. These additional samples are not shipped or mailed to the same address that you send your monthly routine bacteriological samples so check the instructions carefully.
- D. Use the Public Water System (PWS) identification number you have been assigned on all correspondence and sampling forms. It is a seven digit number preceded by the letters MO. Be sure the seven digit number is on the bacteriological sampling card you fill out for the monthly sample. If you do not put the correct PWS ID-number on the form, you may not get credit for taking the sample.
- E. Failure to do sampling may result in legal action against the owner and the operator of the public water system. In the case of a small subdivision, each property owner may be liable as an owner of the system. See Section 11 for more information on noncompliance with regulations.
- F. All community public water systems must collect an annual primacy fee from each customer service connection, for both unmetered and metered customers and customers with meters. The primacy fee rate for each customer is based on the size of the meter and the number of meters used per customer. Public water systems are responsible for collecting the

annual primacy fees from each customer and are remitting primacy fees collected to the Department of Natural Resources by the end of each calendar quarter in which the fees were collected.

- G. All privately owned community public water systems must pay annual laboratory services and program administration fees. The annual fee for all groundwater systems and secondary public water systems that serve water to 4,100 or fewer service connections is \$200.
- H. Missouri safe drinking water regulations requires owners of public water systems to get prior written approval from the department before any construction, expansions, modifications and improvements of the water system's source, water treatment facility or to develop a new community water system. This also includes distribution water line extensions and changing motor size and storage tanks. Prior approval would not be required for adding service connections, or replacing a pump or motor with the same size and speed unit.

Approvals will help eliminate unnecessary design problems in the drinking water system. Accurate "as-built" plans of the water distribution system are necessary to operate and find water mains during water main breaks. The system must set a strict policy requiring detailed construction measurements be taken and as-built plans be developed on each new water main.

SECTION 2 – Monthly sampling for bacteria, general information

- A. The sample collected by water systems each month is referred to as the “routine” sample. The number of samples is determined by the population served and the type of treatment provided. These routine samples should be representative of water throughout the distribution system and must be collected from sites in accordance with a written sample siting plan. The Department of Natural Resources can help water systems create a bacteriological sample siting plan or update an existing sample siting plan.
- B. Each sample is analyzed for the presence or absence of total coliform bacteria. This group of bacteria is naturally occurring and abundant in the environment around us but should not be present in the source water or throughout the public water system distribution system. The presence of total coliform bacteria in a routine sample indicates there could be more harmful microbial pathogens in the water requiring additional samples in a short period of time. Proper sampling procedures should be followed when collecting samples, so unintentional contamination does not cause a routine sample to test positive for total coliform bacteria. It is best to have the same person collect the sample each month. The Department of Natural Resources offers technical assistance for sample collecting.
- C. Routine samples are to be collected each month. Water systems cannot collect two samples in one month and get credit for two months.

Complete all required parts of the bacteriological sampling card included in each sample box. Put your name and telephone number so the department can contact you if there is a problem. The most common errors are failure to include ID # and leaving off the date and time and type of sample. Failure to provide required information will result in the sample being discarded and not analyzed. If the form is not complete, the sample will not be accepted and the water system will have to collect another sample in order to receive credit for the monitoring period.

- D. Please write or print legibly.
- E. Bacteriological samples must be to the laboratory within 30 hours of collection or they will not be accepted. If you plan to mail a sample, Do NOT collect samples on a Friday or when holidays will interfere with delivery of the samples.
- Every year, the department mails out a bacteriological sampling schedule to help public water systems with the collection of monthly routine samples. A copy of the schedule can be requested by calling 800-361-4827 or visiting www.dnr.mo.gov/env/wpp/monitoring.htm.
- F. If the bacteriological sampling card is not be completely filled out with required information or the sample fails to arrive at the lab within 30 hours of collection, the water system will be notified that the sample was invalidated (not tested) and required to send in another sample. This type of sample will need to be marked as “replacement.”
- G. If you are using the Missouri State Public Health Laboratory, it may be best to use the courier service. Most county health departments serve as pick-up locations for a courier service that delivers samples to the State Health Laboratory each business day. A complete list of locations and pick-up times is available online at www.dnr.mo.gov/env/wpp/pdwb/courier-list.pdf
- H. Sample results are typically available within three to four business days after collection and can be accessed in Missouri Drinking Water Watch at www.dnr.mo.gov/DWW/ and selecting your water system and clicking on TCR Sample Results.

Detailed instructions are printed on the back side of each sample card.

ROUTINE:
Check this
box for your
monthly
sample.

REPEAT: Check this box if your **Routine** sample was positive for total coliform/ E. coli bacteria. A PWS must collect a set of repeat samples within 24 hours of notification. .

PWS ID#: Your 7-digit identification number must be entered to process this sample and give you proper credit.

Bottle No:
Enter bottle
number
from
container.

**Chlorine Level
(free and
total):**
Must be
recorded if
chlorine is

Collection Point: Must be completed with a location; like “Utility Room”, or “Kitchen”

SEE REVERSE SIDE FOR INSTRUCTIONS

PUBLIC WATER SYSTEM NAME AND ADDRESS		BOTTLE NO.	
SUPPLY NAME		MISSOURI DEPARTMENT OF HEALTH AND SENIOR SERVICES STATE PUBLIC HEALTH LABORATORY BACTERIOLOGICAL WATER ANALYSIS CHLORINE RESIDUAL (AT COLLECTION POINT)	
STREET ADDRESS			
CITY			
COUNTY			
		FREE	TOTAL
		mg/l	mg/l

▲ LAB USE ONLY ▲		COLLECTION POINT		SAMPLE TYPE		REPEAT LOCATION (CHECK ONE)		SAMPLE DATE AND TIME				COLLECTED BY			
REPLACEMENT (FOR OUTDATED/INVALID) SOURCE/WELL SPECIAL		ROUTINE		REPEAT →		<input type="checkbox"/> ORIGINAL <input type="checkbox"/> UP <input type="checkbox"/> DOWN <input type="checkbox"/> SOURCE or OTHER		MO		DAY		YR		TIME (24 HR-MILITARY TIME)	
SAMPLE LOCATION ID														DAYTIME PHONE NO.	

RETURN TOP TWO COPIES		ANALYSIS RESULT		LAB USE ONLY	
PWS IS M O		<input type="checkbox"/> Coliform Absent <input type="checkbox"/> Coliform Present <input type="checkbox"/> Over 30 Hours Unsatisfactory		<input type="checkbox"/> E. coli Absent <input type="checkbox"/> E. coli Present <input type="checkbox"/>	

LAB 10B

REPLACEMENT: Check this box to “Replace” an invalidated sample. A sample can be invalidated if it arrives at the lab too late, if the bottle is overfilled, does not have enough water, or when a bottle cracks and leaks during transport. An invalid sample will not count for the total samples required each month. Water systems are responsible for replacing invalid samples.

SOURCE/WELL: Check if the sample came directly from a well prior to treatment. This is required for systems using wells without chlorine contact time (provides and monitors for 4-log inactivation of viruses) when the monthly routine sample is coliform positive.

SPECIAL: Check this box if you are submitting a sample that is not intended to be counted towards your monthly sample requirement. For instance, if you recently replaced your pump or a section of line and want to be sure that no contamination entered your system. If the special sample is found to be coliform present you will not receive a violation notice. Special samples do NOT count for the required monthly samples.

DATE and TIME:
This is very important.
For **DATE**, use 2 digits
for month, day, and
year. April 1, 2012
would be written as
|0|4|0|1|1|2|. **TIME** is
recorded in military
time. Use the 24 hour
clock to record the time
sample was collected.
sample card.

Normal Time	Military Time	Normal Time	Military Time
12:00 AM	0000	12:00 PM	1200
1:00 AM	0100	1:00 PM	1300
2:00 AM	0200	2:00 PM	1400
3:00 AM	0300	3:00 PM	1500
4:00 AM	0400	4:00 PM	1600
5:00 AM	0500	5:00 PM	1700
6:00 AM	0600	6:00 PM	1800
7:00 AM	0700	7:00 PM	1900
8:00 AM	0800	8:00 PM	2000
9:00 AM	0900	9:00 PM	2100
10:00 AM	1000	10:00 PM	2200
11:00 AM	1100	11:00 PM	2300

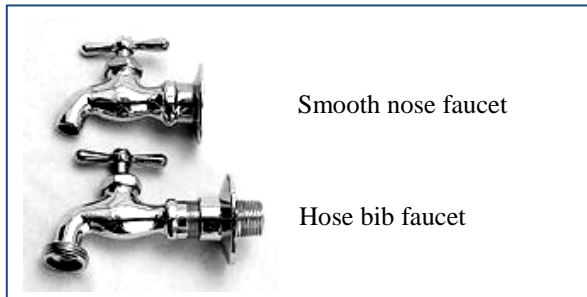
Military Time Explained

TIME: Time is recorded in military time. For instance, if you collect a sample at 8 a.m., you would write “0800,” if you collect a sample at 3 p.m., you would write “1500.” The lab will not accept samples that are over 30 hours in holding time. This diagram can assist you in determining the correct time to write on the sample card.

SECTION 3 – Monthly sampling for bacteria: Proper Bacteriological Sampling Procedure

Tap Selection

The first step in collecting samples for microbiological analysis is to select the sample tap. Samples should be taken from a clean, smooth-nosed, cold water tap, free of attachments (hoses, aerators, screens, etc.). Unfortunately, smooth-nosed, cold-water taps are becoming difficult to find. Often, the best alternative is a standard hose bib or ball valve (as shown). Some



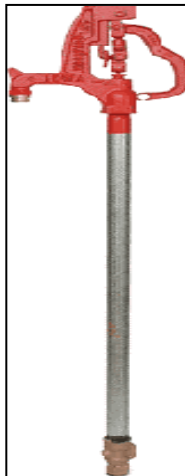
Smooth nose faucet

Hose bib faucet

combination hot and cold faucets can be used to collect with appropriate precautions.

Dripping faucets or those that leak around the valve stem or faucet base should be avoided. These are difficult to disinfect and have obvious avenues of contamination. Swinging faucets and faucets with risers should be avoided unless you have no other good sampling taps because the

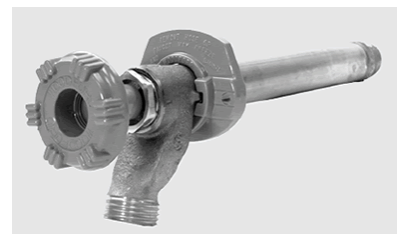
mechanism that allows them to swing can also allow contamination into the water. Also, water constantly stands between the valves and the discharge of these faucets. This standing water can grow bacteria and other organisms.



Samples should never be drawn from a yard hydrant of any type. Yard hydrants have weep holes or other mechanisms to drain the water standing in the risers and keep the hydrants from freezing. These drainage mechanisms allow surface water to enter the hydrant riser contaminate the hydrant and grow bacteria and other organisms.

Another type of water tap that should be avoided if possible is a freeze proof sillcock (shown below). These are often called hose bibs. To keep from freezing the valve that controls the faucet is located inside of the house 16 or more inches away from the faucet end of the sillcock. If not installed properly, bacteria and other organisms can grow in the sillcock barrel. Also, just the process of attaching a hose to the hose bib can contaminate the hose bib.

Do not collect samples from outside faucets closely surrounded by tall vegetation since the opportunity for contamination during sampling is very high. If the sample tap is outside and it is raining or the wind is blowing hard do not collect the sample. It is very difficult to keep from contaminating the sample container under these conditions. Not all commercially made sampling stations are created equal and some are no better than yard hydrants. Thus, even sampling stations must be viewed critically before collecting a sample.



Before deciding on a sample site, first check if there is a softener, a filter, or other type of treatment. The resin media in a water softener can easily become contaminated due to unsanitary handling or storage of the salt. Treatment and softening units can cause positive samples.

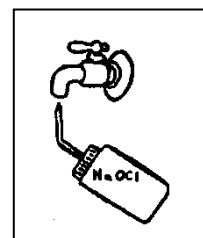
In systems that disinfect, the treatment units can result in no chlorine residuals in the customer plumbing. Try to find a tap before the treatment unit or do not collect a sample at this location.

Procedures Prior to Sample Collection

1. **Assemble all of the sampling supplies before you begin:** the sample bottles with shipping labels, sample forms, and chlorine disinfectant for the faucet. The sample bottles are sterilized, so handle them carefully. If your water system provides chlorination treatment, you will also need an approved chlorine test kit to measure the chlorine residual. The results must be recorded on the sample form.
2. **Use sterile sample collection technique.** Wash your hands thoroughly before handling supplies and always wear clean clothes. Bacteria can be transferred from clothes to the sample through the air. A number of coliform positive samples have been traced back to improper sample collecting technique.

Preparation for Collecting a Sample

3. **Once you have selected the best possible sampling location,** inspect for and remove any aerator, strainer, gasket, loose dirt, hose, extension, or other attachment on the sample tap that may harbor bacteria and interfere with tap disinfection. If you use pliers or other tools to remove an aerator or strainer, be very careful not to mar or damage it. Wrapping the device in a paper towel helps but if the device is not easily removed choose a different sample tap. Once the screen is taken off let the cold water run for two minutes to flush out the faucet and old water sitting in the pipes for extended periods.
4. **Disinfect the tap from its nose to the valve.** You can disinfect the tap by thoroughly rinsing both the inside and outside with a 100 ppm sodium hypochlorite (bleach) solution. Mix at least ¼ teaspoon per pint (or ½ teaspoon per quart) of household bleach to clean tap water. Please only mix up enough solution to last two to three months. If you do not use it up in three months dump the solution and make a new batch. A squeeze bottle (Nalgene bottle) filled with a bleach solution is the easiest way to apply the solution and to get the solution inside the faucet to the valve. Otherwise use a spray bottle with an adjustable spray nozzle. Strong bleach solutions can damage things so try to keep the bleach contained to the sample tap and protect things around the tap. If the tap is dirty, wipe it off with paper towels and let the bleach solution remain in contact with tap for three minutes if you are indoors, and at least five minutes if collecting a sample outdoors with temperatures under 45°F.
5. **Open the cold water tap and flush for about three minutes before collecting the sample.** This additional time is good to clear the chlorine off the faucet and out the service line and get fresh water from the water main. Use this time to fill in the required information on the sample card.



NOTE: This is the best time to test the free and total chlorine in the system if the water system disinfects. The free chlorine reading should be taken within 60 seconds of adding the reagents. It takes three minutes for the DPD chemistry to work for the total chlorine test. It

is really important to test the free and total chlorine because it is the only way an operator can tell what is happening in the distribution system. If the free chlorine is not 80 percent or more of the total chlorine this could indicate a contamination issue in the distribution system. At this point it would be advisable to call the department's regional office and start flushing the system. The procedure requires flushing a lot of water, which can create a major mess if a drain is not available. Without a drain, the water must be run into a bucket and disposed of safely.

6. **After flushing the tap for three minutes reduce to a gentle flow.** Check for steady flow, about the width of a pencil. Do not change the water flow once you have started sampling. It could dislodge microbial growth.
7. **Note: hot-cold mixing faucets with swivel heads normally found in kitchens are generally not recommended.** However in many small systems this may be the only option. If there are no recommended taps available a mixing faucet can be used if the following procedure is used. First remove the screen on the faucet and turn on the hot water for three minutes. This helps to clean this side of the faucet and the heated water will make the chlorine more reactive. Be sure to follow the instructions in step 4 on chlorine application. Once the chlorine is applied let it sit for at least three minutes before turning on the cold water for another three minutes. Then the flow can be reduced to fill the bottle.

Sample Collection Procedures

The following steps describe sample collection procedures for coliform analysis and are only to be performed if steps 1-7 have been completed.

Inspect sample bottle before use. If the seal on the bottle has been broken or there is a crack in the bottle, discard and get another sample bottle. Do not rinse out a bottle before collecting the sample! The crystals or drops of liquid inside the bottle are de-chlorinating chemicals and are necessary for collecting valid samples.

8. **Grasp cap along top edge and remove carefully.** Be sure not to touch the inside of the cap or the bottle lip with anything. Hold the bottle in one hand and hold the cap down in the other. Do not lay the cap down. Do not hold the cap upside down where dirt or other contaminants can fall or blow into the cap. If you think you may have contaminated the bottle or lid during sampling empty the bottle, throw it away and get another bottle. Do not return it to the laboratory for sterilization, these bottles are disposable.

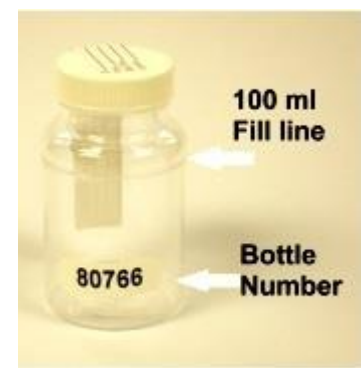
9. **Allow gentle flowing cold water (pencil width) to fill bottle just above the 100ml fill line to the shoulder of the bottle.** Hold the bottle so that water will directly enter the bottle and will not come in contact with anything else first. Samples will not be tested if there is less than one -half inch air space in the bottle, so do NOT overfill.

10. **Place the cap on the bottle and screw it down firmly.** Do not over tighten as this could cause the lid to crack and leak.

11. **Turn the tap off.** Replace any aerator, strainer or hose.

12. **Complete the bacteriological water analysis card** with the necessary sample collection information. **Be certain the time and date are correct.** Fill out a separate water analyses

BACTERIOLOGICAL
SAMPLE BOTTLE



card for each water sample submitted. Supply all information requested on the form and enclose with the sample bottle. Be certain the number on the form matches the number on the bottle. It is not necessary to fill out the small label on the bottle, just use the number from the bottle on the sampling card. **Samples with incomplete collection information could be invalidated and not tested.**

13. DO NOT place correspondence in the box with the bacteriological sample. To prevent running out of sample bottles, be sure to order more while you still have an adequate supply. To reorder, use the orange order card included in the large box of individual boxes or contact the department's Public Drinking Water Branch at 573 751-5331 or visit www.dnr.mo.gov/env/wpp/labs/water-analysis.htm.

14. Samples must reach the laboratory within 30 hours of collection. To ensure the sample arrives to the State Public Health Laboratory on time, it is best to use the courier service offered by the Missouri Department of Health and Senior Services. Pick up locations can be found at www.dnr.mo.gov/env/wpp/pdwb/courier-list.pdf. Samples may be collected Monday through Thursday. In special circumstances, samples may be sent by the courier service, on Fridays. Contact the appropriate Department of Health and Senior Services Laboratory (573-751-3334) to ensure a lab analyst is informed of the samples to be delivered and is available to set the samples up.

15. Ship samples immediately after collection. Avoid collecting early in the morning if the courier or mail does not pick up until much later in the day. This is important because the holding time is only 30 hours. For example: samples collected early in the morning Monday arrive late that evening and processing will not begin until Tuesday morning. On days where a large number of samples arrive (up to 600 in a day) the final samples may not be checked in until after noon; and so those collected early on Monday could be expired.

If you intend to mail the sample ask your local post office if Priority Mail would be faster than First Class. If you use another private laboratory, follow its shipping procedures.

16. You may use a certified private laboratory instead of the State Public Health Laboratory. If you use a private laboratory, you must use sample containers provided by that private laboratory. Some private laboratories provide water systems with a copy of the results but do not mail a copy to the department. It is the public water system's responsibility to ensure a copy of the results is mailed to the department by the 10th of the following month. If the department does not receive the sample report, the public water system may receive a monitoring violation.

MAILING LABEL

FROM:
TO:
MISSOURI DEPARTMENT OF HEALTH AND SENIOR SERVICES STATE PUBLIC HEALTH LABORATORY 101 N CHESTNUT P O BOX 570 JEFFERSON CITY MO 65102
WATER SAMPLE FIRST CLASS MAIL

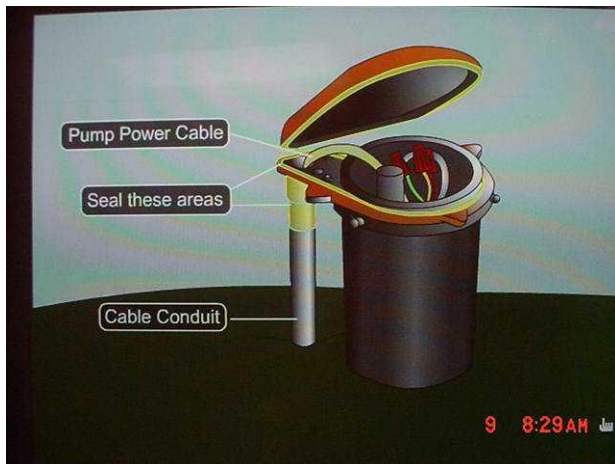
MO 580-0904 (5-06) IT IS ILLEGAL TO USE THIS CONTAINER FOR WORK TO OTHER THAN SPHL. LAB-9 (RS-06)

SECTION 4 – Making sure your well is not the cause of bad samples

A. Most groundwater in Missouri meets regulatory standards. The most common failure is due to contamination that entered the well through the wellhead. The wellhead is the part of the well pipe that extends above ground or floor level. Remember that a well is just a hole in the ground with a pipe in it and the pipe extends down into the ground directly into the water you are pumping back to the surface to use. Therefore, if there is a way for environmental

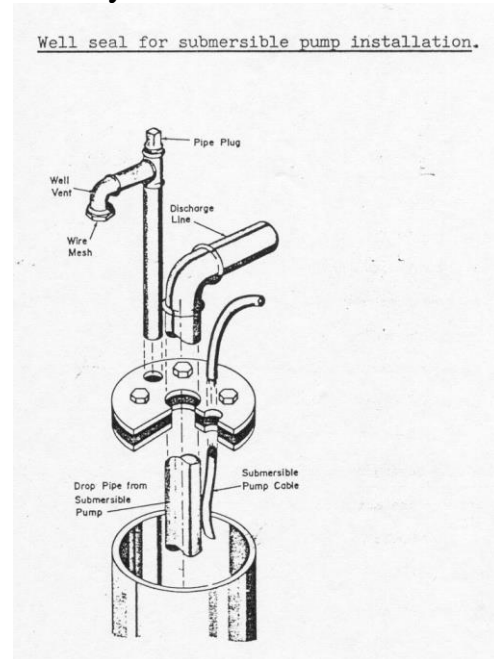
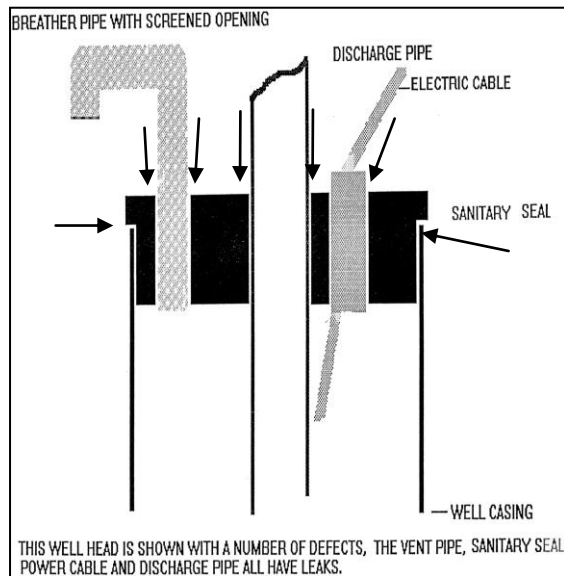
contaminants such as dust, dirty water or insects to get into your wellhead, it is a straight shot down into your water.

- B. The first line of defense is to be sure the wellhead is properly sealed. Caulk is only a temporary fix and the gaskets will still need to be replaced the next time work is done on the well. This is the best way to prevent contamination from entering around the gasket, wiring, or piping. A downward pointing, screened vent should be the only opening in the wellhead. This vent is necessary to allow air to enter the well when water is being pumped out and to allow air to be expelled when the pump shuts off and underground water comes in to replace the water that was pumped out. These vents must be properly constructed and screened or contamination may enter along with air. It is not possible to tell by a casual examination if the wellhead is properly sealed. If the wellhead is located outdoors or is close to the ground, the possibility of contamination is greater. A department staff member can help you decide if improvements are needed.
- C. Sometimes wellheads are improperly constructed, which makes it more difficult to seal. A Department of Natural Resources inspector can examine your wellhead and tell you if improvements need to be made. The area around the wellhead should be kept clean to minimize contamination entering through the vent. The following information can assist with determining key areas to seal on your wellhead. The arrows show sites where contamination can enter your well. If you have work done on your well, be sure to disinfect it or you may get bad samples when the well is put back into service.



The picture shown on the left is a pitless type well. It is very important to ensure the cap on this type of well is securely fastened to guard against contamination entering the well.

Diagrams of a well with a sanitary seal.



SECTION 5 – What to do when a sample is positive for coliform or E. coli bacteria

- A. Sometimes in spite of taking all the necessary precautions, you may get a call from the Department of Natural Resources telling you that you have coliform bacteria in your water. You will then be given specific instructions that may include collection of repeat samples to confirm that the first routine sample was not a sampling error. If the repeat samples also have bacteria, you may be instructed to disinfect the system. Please do not disinfect or shock and flush the system until the department's regional office has given you approval to start that process. You can either do this yourself or have a well service company do it (for water systems with a well). If you decide to do it yourself you will be given specific instructions on how to accomplish this. After disinfecting the well, either flush the system or wait until the chlorine is gone through normal usage before taking more samples.

If you use a private laboratory, your only notification may be the sample report in the mail. The department's regional office typically will not receive a notification from private labs of a positive sample. Always read your sample report when it arrives. If you do not receive a call, please contact your regional office anytime a routine sample is coliform or E-coli positive.

- B. **Whenever a sample tests positive for coliform bacteria, public water supplies are required to collect five routine samples the following month.** If all five of these routine samples are absent of total coliform bacteria the water system will return to its regular sample schedule the next month.
- C. Maximum Contaminant Level violations (MCL) are issued to a public water system when 5 percent or more of all of the bacteriological samples collected in a month are positive for total coliform bacteria. For water systems that collect fewer than 40 samples per month, this

will occur when two or more monthly samples are present for total coliform. If one of the repeat samples is also positive for E. coli bacteria, this is an acute MCL violation and a boil water notice will be required. The public water system must provide immediate notification to their customers.

- D. Under the Ground Water Rule if a “source/well” sample tests positive for E. coli bacteria, the public water system must collect five additional or confirmation source/well samples. If any one of the five confirmation source/well samples tests positive for E. coli bacteria, the public water system must consult with the department within 30 days to agree on action to correct the contamination of the well.
- E. If your public water system exceeds the maximum contaminant level for the monitoring period, then it may be necessary to disinfect the distribution system to kill the bacteria. Regional office staff can discuss this disinfection and flushing procedure with you. Please review the Disinfecting Small Drinking Water Systems guidance document at the end of this document for more information.

SECTION 6 – Disinfection

- A. Some water systems disinfect the water pumped from the well before it is used. This could be done merely as a precaution, to improve taste and odor of the water, or because of a history of bacteria in the source.
- B. The most common method of disinfection is the use of a chlorine product to kill bacteria. This method requires that chlorine be added to the water followed by a holding time to allow the chlorine to kill bacteria and inactivate viruses. This means that some storage volume is required to allow contact time for the chlorine to work. Department staff can assist you in determining if you have adequate contact time.

Chlorine is usually added in the well house by injecting a chlorine and water solution into the piping with a small pump soon after the water comes out of the well. Systems that drop chlorine pellets into the well are not allowed by the department and must be removed and or replaced with a disinfection system approved by the department. Pellet chlorinators cause corrosion to the well casing and it is not possible to accurately control the amount of chlorine in the water. In addition, under the Ground Water Rule, ground water systems not providing 4-log virus inactivation must be able to collect a source/well sample prior any chemical treatment. Dropping chlorine pellets down the well makes this required source sampling impossible.

- C. Any water system that provides any type or form of treatment must perform sufficient testing to maintain control of the treatment process. Any water system that adds chlorine must monitor the chlorine concentration level (residual) in the water daily at the entrance to distribution and record the results. A variety of test kits are available for testing the chlorine residual. Maintaining adequate chlorine residual provides assurance that enough chlorine is in the water to effectively treat the water.

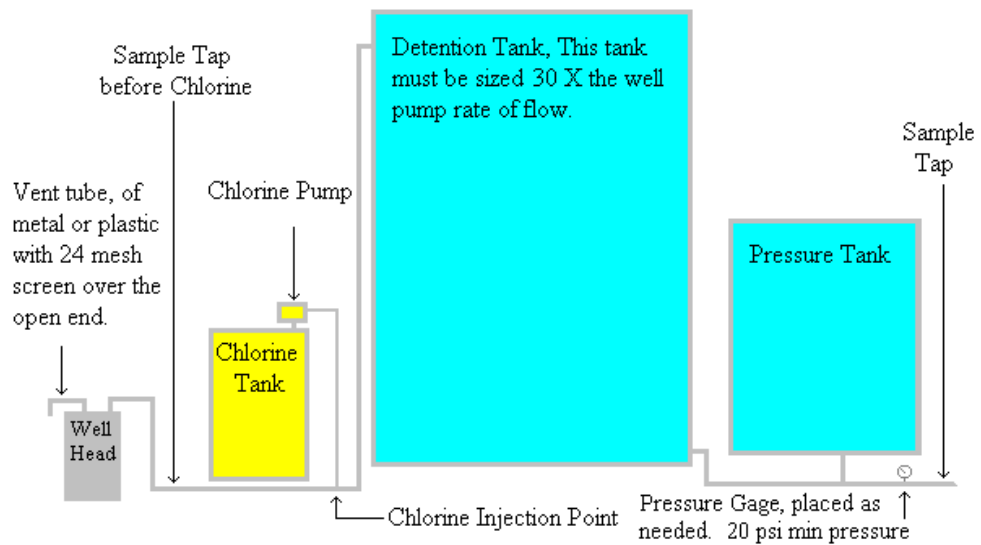
For systems adding free available chlorine in the form of chlorine gas or a sodium hypochlorite solution (common unscented household bleach), the chlorine residual entering the distribution (leaving the well house) cannot be less than 0.5 mg/L (milligrams per liter)

of free chlorine for more than four hours. The chlorine residual must also be measured at the same point in the distribution system and at the same time as each bacteriological sample is collected out in the distribution system. The chlorine residual in the distribution system should never drop below 0.2 mg/L of total chlorine. There is a section on each bacteriological sampling card to report the free chlorine and total chlorine residuals. It is a recommended practice to measure and report both the free chlorine and total chlorine residuals to help identify areas in the distribution system of high chlorine demand. Notify the department as soon as possible but no later than the next business day if the chlorine residual drops below the required minimum residuals.



There are numerous manufactures of handheld colorimeters that use the DPD method and have a digital display for chlorine residual concentration levels. The department does not allow the use of pool test kits that require visual comparison of colors to measure and report chlorine residuals.

- D. Digital colorimeters are the required tool for measuring free chlorine and total chlorine residual. These devices have the accuracy required by federal requirements. Color wheels and color comparators are very subjective and far less accurate. If you are required to maintain specific chlorine residual, you want instrumentation that can reliably and objectively provide accurate results. Digital colorimeters are accurate and fast, however they do require some skill and must be routinely calibrated against a standard. The DPD method is the only accepted method for reporting chlorine residual to the department. Pool testing devices using color wheels or color comparators are not acceptable for public water systems.

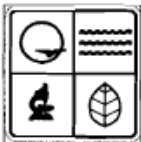



Example of a properly set up liquid chlorine injection system

SECTION 7 – Sample Results

- A. Public water systems will receive written confirmation of sample results: coliform absent or present (good or bad). It may take some time before you get the written results but if the samples are positive for coliform you will also be notified by telephone. When you get the lab report, carefully read the letter because there may be information or instructions you need. You are responsible for collecting any additional samples. If you have any questions regarding your sample results, please call for assistance. Bacteriological sample reports must be kept for five years, and chemical sample reports for 10 years. Please review the “Record Maintenance List” on page 32.

The following is a sample bacteriological report:

	Missouri Department Of Natural Resources Public Drinking Water Program P.O. Box 176 Jefferson City, MO 65102 (573)751-5331	
Public Water System Bacteriological Report		
PWS Name :	PWS ID :	
Mail to :	County :	
Please notify us of any name and address changes		
Date Collected :	Collector :	Sample Type :
Lab Sample ID :	Location Name:	Location ID:
		05
		P
Sample tested positive for total coliform. This positive sample may require follow up samples to be collected. Please contact your local regional office at [redacted] for further sampling instructions.		
Note to public water systems: If you take a routine sample from a well rather than your distribution system, a violation may be issued by Missouri Public Drinking Water Branch.		

If the sample were absent for total coliform bacteria (no coliform bacteria detected), the lab result would read A for Absent. If the sample were present for total coliform bacteria, the lab result would read P for Present. A positive sample may require follow up samples to be collected. Please contact your local regional office for further sampling instructions.

SECTION 8 – What is a Boil Order or Boil Water Notice?

If a certain type of bacteria called E. coli is present in your monthly bacteriological sample, you may be required to issue a boil water notice at your public water system. You will be informed if this happens and given information on what actions you must take. A boil water notice means the water is unsafe for human consumption without first boiling the water.

E. coli bacteria are a specific group of coliform bacteria that naturally occurs in the gut and feces of warm-blooded animals. Several species of E. coli are harmful and cause serious life threatening symptoms in people. This is a serious situation and you must follow all instructions given to you by the Department of Natural Resources. Customers should not use the water in any food preparation unless it has been properly disinfected. If the public has access to the water, they have to be warned that it is not safe to use for human consumption. An example boil notice and fact sheets on boil water orders and advisories can be found at: dnr.mo.gov/pubs/index.html#DrinkingWater.

A boil water order is an administrative order issued by the Missouri Department of Natural Resources to a public water system when a threat to the public health exists. A boil water notice is issued by the water system to their customers.

SECTION 9 – Change of Owners, Operators and Sample Collectors

It is essential that the Department of Natural Resources have current information on who is the responsible person for the water system. If there is a change in owners, the mailing addresses, or person who takes the water samples, please call or write to the department's regional office. Do not put a note in the monthly sampling bottle box. The Missouri State Public Health Laboratory is operated by the Missouri Department of Health and Senior Services and notifying them does not notify the Department of Natural Resources.

All community water systems are required to have a certified operator. Within 10 working days of hiring a new operator, changing the chief operator, or if the chief operator leaves, the water system must notify the local regional office. Upon hiring an operator, please provide the name and certification number of the new operator, and a copy of the contract.

If the water system is a business, such as a mobile home park, and is sold, the seller must notify the department and have the operating permit transferred to the new owner. Until the operating permit is transferred, the previous owner could be held responsible for all violations the water system could incur from failure to sample, or other regulatory violations.

An application for the transfer of a permit to dispense water, form number 780-1517, must be completed when ownership changes for a facility that already has a permit to dispense. The form is available at www.dnr.mo.gov/form/index.html#DrinkingWater



MISSOURI DEPARTMENT OF NATURAL RESOURCES
WATER PROTECTION PROGRAM
PERMIT TO DISPENSE TRANSFER APPLICATION

DATE RECEIVED

Per 10 CSR 60-3.020 (3) Owners of all public water systems commencing operation after October 1, 1999 applying for written construction authorizations, permits to dispense, or both, shall show in accordance with 10 CSR 60-3.020 (6) that a permanent organization exists which will serve as the continuing operating authority for the management, operation, replacement, maintenance and modernization of the facility for which the application is made. Construction authorizations and permits to dispense will not be issued unless the applicant provides proof satisfactory to the department that a continuing operating authority exists that shall have jurisdiction over the facility. Written construction authorization and permits to dispense water will be issued to the continuing operating authority and shall be valid only for the continuing operating authority to which the permit is issued.

1. SYSTEM CLASSIFICATION

☐ COMMUNITY ☐ NON-TRANSIENT NON-COMMUNITY ☐ TRANSIENT NON-COMMUNITY

2. NAME OF WATER SYSTEM

COUNTY

PWS ID NUMBER

MO

ADDRESS 1

ADDRESS 2

CITY

STATE

ZIPCODE

3. ANTICIPATED EFFECTIVE DATE OF TRANSFER OF OWNERSHIP

4. REQUIRED DOCUMENTS:

☐ ONCE THE TRANSFER OF OWNERSHIP IS COMPLETE PROVIDE A COPY OF THE PROPERTY DEEDS FOR ALL WELL(S), WELL HOUSE(S), STORAGE TANK(S) AND TREATMENT PLANT(S)

☐ EMERGENCY OPERATIONS PLAN

NOTE: For owner/official custodian—for a sole proprietorship-the name of the proprietor, for a corporation-the name of an officer of at least the level of a plant manager; for a partnership-the name of a principal partner; for a city, state, federal or other public facility-the name of either a principal executive officer or a ranking public official.

5. NAME OF CONTINUING OPERATING AUTHORITY BEFORE THE SALE

6. NAME OF CONTINUING OPERATING AUTHORITY AFTER THE SALE

PRINT NAME OF OWNER BEFORE THE SALE

PRINT NAME OF OWNER AFTER THE SALE

ADDRESS 1

ADDRESS 1

TELEPHONE NUMBER WITH AREA CODE

E-MAIL ADDRESS

TELEPHONE NUMBER WITH AREA CODE

E-MAIL ADDRESS

CITY

STATE

ZIPCODE

CITY

STATE

ZIPCODE

I CERTIFY THAT I AM FAMILIAR WITH THE INFORMATION GIVEN ABOVE, THAT TO THE BEST OF MY KNOWLEDGE AND BELIEF SUCH INFORMATION IS TRUE, COMPLETE AND ACCURATE, AND UPON OWNERSHIP TRANSFER, I AGREE TO ABIDE BY THE MISSOURI SAFE DRINKING WATER LAW SECTIONS 640.100—640.140, RSMo AND ALL RULES AND REGULATIONS UNDER THE MISSOURI SAFE DRINKING WATER LAW.

SIGNATURE OF OWNER BEFORE SALE

DATE

SIGNATURE OF OWNER AFTER THE SALE

DATE

SECTION 10 – Noncompliance with regulations



- A. Enforcement of the public drinking water standards is required by state and federal law and regulations. If you have violations of the regulations you may be required to sign a document agreeing to correct any observed deficiencies. If you are notified that you are in violation of any regulations please contact the Department of Natural Resources and one of our staff will discuss the violation and help you understand what you are required to do.

A monitoring violation is issued when you fail to collect a required monthly sample.

A maximum contaminant level violation (MCL) is issued to a facility when 5 percent or more monthly bacteriological samples are present for coliform or e.coli bacteria.



The forms on the following pages are examples of monitoring and maximum contaminant level violations for bacteriological quality:

Notice of Violation for failing to collect required number of samples for bacteriological quality:

	<p>Missouri Department of Natural Resources Water Protection Program Public Drinking Water Branch P.O. Box 176 Jefferson City, MO 65102-0176</p>							
<p>Notice of Noncompliance Public Notice Required</p>								
Date of Report: _____	PWS ID: _____	Month Violation Occurred						
PWS Name: _____	County: _____							
Mail to: _____ _____ _____								
<p><i>Please notify us of any name or address changes</i></p>								
<p>The following is a summary of the bacteriological analysis of water samples submitted for the period ending ____.</p>								
<table border="1" style="margin: auto;"><thead><tr><th>Sample Type</th><th>Number Required</th><th>Number Taken</th></tr></thead><tbody><tr><td>Routine</td><td>1 per MN</td><td>Zero</td></tr></tbody></table>			Sample Type	Number Required	Number Taken	Routine	1 per MN	Zero
Sample Type	Number Required	Number Taken						
Routine	1 per MN	Zero						
<p>Violation Type: Monitoring (TCR), Routine Major</p>								
<p>This is a violation of 10 CSR 60-4.020(1). No routine drinking water samples were collected for the testing of total coliform bacteria.</p>								
<p>Required Actions:</p> <ol style="list-style-type: none">1. The enclosures give instructions on how to perform public notice and a copy of the public notice itself to distribute, post and provide to any media.2. Fill in the appropriate information requested on the certification page and sign where indicated.3. Make copies of the certification and public notice (as seen by the public) for your files.4. Send the completed certification and a copy of the public notice (as seen by the public) back to DNR at the address given.								
<p>For assistance, contact the _____ Regional Office at _____ or the Public Drinking Water Branch at (573) 751-5331.</p>								


Notice of Violation (NOV) for failing to send in a monthly bacteriological sample.

Notice of violation for exceeding maximum contaminant level for bacteriological quality:

	<p>Missouri Department of Natural Resources Water Protection Program Public Drinking Water Branch P.O. Box 176 Jefferson City, MO 65102-0176</p>										
Notice of Noncompliance Public Notice Required											
Date of Report: <input type="text"/>	PWS ID: <input type="text"/>	Month violation occurred									
PWS Name: <input type="text"/>	County: <input type="text"/>										
Mail to: <input type="text"/>											
<input type="text"/>											
<i>Please notify us of any name or address changes</i>											
<p>The following is a summary of the bacteriological analysis of water samples submitted for the period ending <input type="text"/>.</p>											
<table border="1" style="margin: auto;"><thead><tr><th>Sample Type</th><th>Total Coliform Positive</th><th>E coli Positive</th></tr></thead><tbody><tr><td>RT</td><td>1</td><td>0</td></tr><tr><td>RP</td><td>3</td><td>0</td></tr></tbody></table>			Sample Type	Total Coliform Positive	E coli Positive	RT	1	0	RP	3	0
Sample Type	Total Coliform Positive	E coli Positive									
RT	1	0									
RP	3	0									
<div style="border: 1px solid red; padding: 5px; display: inline-block;">Notice of Violation for exceeding Maximum Contaminant Level for bacteriological quality.</div>											
<p>Violation Type: MCL (TCR), Monthly This is a violation of 10 CSR 60-4.020(7)(A). Two or more samples tested positive for total coliform bacteria.</p>											
<p>Required Actions:</p> <ol style="list-style-type: none">1. The enclosures give instructions on how to perform public notice and a copy of the public notice itself to distribute, post and provide to any media.2. Fill in the appropriate information requested on the certification page and sign where indicated.3. Make copies of the certification and public notice (as seen by the public) for your files.4. Send the completed certification and a copy of the public notice (as seen by the public) back to DNR at the address given.											
<p>For assistance, contact the <input type="text"/> Regional Office at <input type="text"/> or the Public Drinking Water Branch at (573) 751-5331.</p>											

Public notice and the public notice certification form must be made and sent in to the department's Public Drinking Water Branch for maximum contaminant level (MCL) violations. The public notice and certification forms for an MCL violation are similar to those used for a monitoring violation.

When issued a notice of violation for a monitoring or a maximum contaminant level violation for bacteriological quality, public notice must be made.

PUBLIC NOTICE-CUSTOMERS OF

FAILURE TO MEET MICROBIOLOGICAL MONITORING REQUIREMENTS
FOR DRINKING WATER

Public Notice

Este informe contiene información muy importante sobre su agua potable. Tradúzcalo o hable con alguien que lo entienda bien.

We are required to monitor your drinking water for specific contaminants on a regular basis. Results of regular monitoring are an indicator of whether or not our drinking water meets health standards. During [redacted] we did not test for total coliform bacteria and therefore cannot be sure of the quality of our drinking water during that time.

This is a violation of Missouri Public Drinking Water Regulations. The Missouri Department of Natural Resources requires that drinking water from this supply be tested for this type of bacteria by submitting at least one valid sample per month. Bacteriologically-contaminated water can cause a variety of disease symptoms. It is important that drinking water be routinely tested to ensure the safety of those who consume it.

Provide explanation of cause of monitoring failure:

For further information contact _____ at _____

(Name of system contact person) (phone #)

or the department's Public Drinking Water Branch at (573) 751-5331

or contact the [redacted] Regional Office at [redacted].

Please share this information with all the other people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

Public Notice Certification Form that must be sent with the public notice form to the Public Drinking Water Branch after posting.

CERTIFICATION

I certify this public water system notified the people it serves by the methods indicated below:

1. ☐ Posting: _____ or ☐ Publication (please attach affidavit)

Begin Posting Date: _____ Newspaper: _____

End Posting Date: _____ Date: _____

Locations: _____

And _____

2. ☐ Included in Consumer Confidence Report or ☐ Other: _____

Date of distribution: _____ Date of distribution: _____

(Signature) (Title) (Date)

PWS ID #: [redacted]

System Name: [redacted]

County: [redacted]

SECTION 11 – Certified operators

- A. Community public water systems are required to have a certified operator. An operator is the person in responsible charge of the water system. If a system does not have a certified operator, it can either have someone from its organization become certified or hire a contract operator.

Visit www.dnr.mo.gov/env/wpp/opcert/oprtrain.htm for helpful brochures and information that outline the requirements to become certified.

To see who is listed as contacts for your system, including the chief operator, or to search for a certified operator available for hire, visit www.dnr.mo.gov/operator. To notify the department of a change in personnel, print out the information, make corrections and mail the corrections to the department's Operator Certification Section, or fax to 573-751-3110.

- B. Certified water operators must attend training to keep their certificate current. To access the department's Operator Certification Information System, including a database of Certified Water Operators, visit www.dnr.mo.gov/operator. Call the department's regional office or Operator Certification Section at 573-751-1600 if you have questions about operator certification.
- C. The most important duty of an operator is to ensure consumers have a safe and reliable supply of water. This can be done by ensuring the water meets all regulatory requirements. The following list is some of the specific job duties. In some water systems, some of these duties may be delegated by the chief operator to other responsible persons in the organization. It is desirable that a list of job duties be established in writing so that all management officials and all consumers are aware of the requirements. In small systems, this list can be an important public relations tool in that it makes consumers aware of the extensive duties that are performed by operators. The list below should be added to as necessary for each specific water system.
1. Collect all required samples.
 2. In chlorinated systems, maintain the chlorination equipment and monitor and maintain required chlorine levels.
 3. Notify consumers of conditions that impact the water system, including regulatory requirements for noncompliance.
 4. Prepare and distribute consumer confidence report.
 5. Supervise all repair and maintenance activities.
 6. Maintain required certificate level.
 7. Keep other management persons informed of status of water system.
 8. Keep informed about new regulatory requirements.
 9. Maintain records pertaining to water system.
 10. Perform any necessary routine maintenance on the system.
 11. Monitor water use and loss.
 12. Keep informed of financial condition of water system.

HIRING A CONTRACT OPERATOR

Missouri Regulation 10 CSR 60-14.010 requires all community and nontransient noncommunity water systems to have a chief operator in responsible charge of the water system. Many small water systems have elected to hire a contract or part time operator.

The proper operation and maintenance of the water system is the responsibility of the facility owner.

It is the ultimate responsibility of the owner to see that the facility is in compliance with regulations, and that any operator hired does have a current and valid operator certificate issued by the department when a certified operator is required for the water or wastewater facility.

Upon hiring an operator, please provide your local regional office with the name and certification number of the new operator within 10 days. A written agreement must be available upon request if the operator is a contract operator. If there is a change of chief operator or if the chief operator leaves, the water system must notify the department within 10 days.

Public water systems must also have a contingency plan for a standby replacement chief operator. This may be, for example, a second employee certified at the chief operator level, a mutual assistance agreement with a neighboring system, or a pre-arrangement with a contract operator.

Please note: The public water system chief operator is in responsible charge of the water system. A contract operator is not simply a sample collector. Any person working under the direction and supervision of a certified operator may collect and submit samples. Safe Drinking Water Regulations (10 CSR 60-Chapter 14) establish requirements for certified operators. Two citations taken from this regulation are shown below.

10 CSR 60-14.010 (4)(E) All process control/system integrity decisions about water quality or quantity that affect public health must be made by a certified operator based on procedures approved by the chief operator.

10 CSR 60-14.010 (4)(F) Contract Operator Agreement.

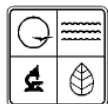
- 1. "Public water systems employing a certified chief operator through a contract operator ("circuit rider") arrange to meet the requirements in subsection (4)(A) shall have a written agreement indicating the responsibilities of the operator, including but not necessarily limited to:*
 - A. The minimum frequency of routine visits to the water treatment facility or distribution system;*
 - C. The operator's duties and responsibilities;*
 - D. The minimum hours the operator will be present for each routine visit;*
 - E. The certification level required by the Department for the treatment facility and/or distribution system that the operator is responsible for;*
 - F. The level of certification held by the contract operator;*
 - G. The minimum response time for the operator to be at the water system in the event of an emergency; and*
 - H. The number of employees, if any, hired to assist.*
- 2. Circuit rider operators and other contract operators who are performing the duties of chief operator shall be held accountable for operational decisions made in their stead.*
- 3. A copy of the current agreement shall be on file at the system at all times and shall be provided to the Department upon request.*

SECTION 12 – Permits to dispense

- A. Each public water system is required by state law to have a permit to dispense water to the public. There is no fee associated with the permit. This permit is similar to having a license for your automobile. Certain requirements must be met before a permit to dispense can be issued. One of the most important requirements is that the well be constructed according to standards. The water distributed to the public also has to meet all applicable standards according to the sampling program discussed earlier. If a water system does not have a permit to dispense, it can apply for one from the department.
- B. If the well you are using was not constructed to be used as a community system, department staff will evaluate the records to determine if the water source can be “grandparented” and have a permit issued on the basis of the system having been in use before the regulations were passed.

The following form must be completed and submitted along with any information you have concerning your water system, such as a well log, within 30 days of becoming a public water system. It is very important to find out any and all information concerning your well (date drilled, well driller, total depth, casing depth). The Public Drinking Water Branch will evaluate the compliance status of your water system and a permit to dispense will be issued after all permitting criteria are met.

- C. The form can also be obtained on the department’s website at:
www.dnr.mo.gov/forms/index.html#DrinkingWater.



MISSOURI DEPARTMENT OF NATURAL RESOURCES
WATER PROTECTION PROGRAM
PUBLIC DRINKING WATER BRANCH
PERMIT TO DISPENSE APPLICATION

FOR OFFICE USE ONLY

DATE RECEIVED

Per 10 CSR 60-3.020 (3) Owners of all public water systems commencing operation after October 1, 1999 applying for written construction authorizations, permits to dispense, or both, shall show in accordance with 10 CSR 60-3.020 (6) that a permanent organization exists which will serve as the continuing operating authority for the management, operation, replacement, maintenance and modernization of the facility for which the application is made. Construction authorizations and permits to dispense will not be issued unless the applicant provides proof satisfactory to the department that a continuing operating authority exists that shall have jurisdiction over the facility. Written construction authorization and permits to dispense water will be issued to the continuing operating authority and shall be valid only for the continuing operating authority to which the permit is issued.

1. SYSTEM CLASSIFICATION

☐ Community ☐ Non-Transient Non-Community ☐ Transient Non-Community

2. NAME OF WATER SYSTEM

COUNTY

PWS ID NUMBER
MO

3. ADDRESS

CITY

ZIP CODE

4. NAME OF PROPERTY OWNER

E-MAIL ADDRESS

TELEPHONE NUMBER WITH AREA CODE

5. ADDRESS

CITY

ZIP CODE

6. CONTINUING OPERATING AUTHORITY (IF SAME AS OWNER INDICATE "SAME")

TELEPHONE NUMBER WITH AREA CODE

7. TYPE OF SUPPLY

☐ City ☐ PWSD ☐ Subdivision ☐ Mobile Home Park
☐ Other (Describe)
☐ Non-Community: (Describe)

8. TMF APPLIES TO ALL COMMUNITY AND NON-TRANSIENT-NON-COMMUNITY SYSTEMS COMMENCING OPERATIONS AFTER OCTOBER 1, 1999

TMF Required: ☐ Yes ☐ No

9. LOCATION OF SOURCE

☐ Well ☐ Intake

U. S. Geological Survey Location _____ 1/4, _____ 1/4, Section _____, T _____, R _____

Geographic Coordinates

Latitude

Longitude

INFORMATION AND VOLUME

10. WELL INFORMATION (REQUIRED)

11. TOTAL VOLUME/STORAGE (REQUIRED)

Total Depth

Water Tower

Gallons

Casing Depth

Ground Storage

☐ Concrete
☐ Steel

Gallons

Pump Capacity

Stand Pipes

Gallons

Well Certification Number

Pressure Tank(S)

Number Of Tanks

Total Gallons

Date Constructed

Other

Gallons

Total

Gallons

IF MORE THAN ONE WELL IS BEING USED, PLEASE PROVIDE THE INFORMATION ON A SEPARATE PAGE

12. AVERAGE NUMBER OF PERSONS PER DAY USING SYSTEM

13. NUMBER OF CONNECTIONS

14. WATER TREATMENT (PLEASE DESCRIBE)

15. DISTRIBUTION SYSTEM (PLEASE DESCRIBE)

REQUIRED MONITORING			
16. MONITORING	Meeting Required Schedule: <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> No History Monitoring Schedule:		
17. CONTAMINANT LEVELS	Meeting Required Levels: <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> No History Problems:		
IF MORE THAN 1 OPERATOR IS BEING USED, PLEASE PROVIDE THE INFORMATION ON A SEPARATE PAGE			
18. OPERATOR	Required To Have Certified Operator: <input type="checkbox"/> Yes <input type="checkbox"/> No		
CHIEF OPERATOR'S NAME	If Yes, What Level:		
CONTACT PHONE NUMBER WITH AREA CODE	Distribution: <input type="checkbox"/> DS-I <input type="checkbox"/> DS-II <input type="checkbox"/> DS-III		
CHIEF OPERATOR'S CERTIFICATION NO.	Treatment: <input type="checkbox"/> DW-A <input type="checkbox"/> DW-B <input type="checkbox"/> DW-C <input type="checkbox"/> DW-D		
	System Has Required Level Of Operator: <input type="checkbox"/> Yes <input type="checkbox"/> No		
	System Has Hired Contract Operator (If Yes, Provide Copy of Agreement) <input type="checkbox"/> Yes <input type="checkbox"/> No		
GRANDFATHERED WELLS ARE NON-COMMUNITY WELLS CONSTRUCTED PRIOR TO JULY 27, 1987 OR COMMUNITY WELLS CONSTRUCTED PRIOR TO SEPTEMBER 14, 1979			
19. WELL GRANDFATHERED?	<input type="checkbox"/> Yes-Well Is Grandfathered <input type="checkbox"/> No-Well Is Not Grandfathered		
20. CONSTRUCTION PERMIT			
Construction Permit Issued? <input type="checkbox"/> Yes <input type="checkbox"/> No	Approval Date:		
If Yes, Review Number:	Final Inspection Date (With Or Without Construction Permit):		
21. REQUIRED DOCUMENTS TO BE PROVIDED INCLUDE:			
<input type="checkbox"/> Copy of Property Deeds For Well(s), Well House(s), Storage Tank(s) and Treatment Plant(s) <input type="checkbox"/> Proof of Ownership <input type="checkbox"/> Well Information-Well Drillers Certification Log or Well Certification <input type="checkbox"/> Emergency Operations Plan <input type="checkbox"/> Sampling Site Plan TMF Documents (In Addition To Above Documents) <input type="checkbox"/> Operational Management Plan <input type="checkbox"/> Financial Capacity Demonstrations <input type="checkbox"/> Distribution System Map			
NOTE: For owner/official custodian—for a sole proprietorship-the name of the proprietor; for a corporation-the name of an officer of at least the level of a plant manager; for a partnership-the name of a principal partner; for a city, state, federal or other public facility-the name of either a principal executive officer or a ranking public official.			
22. ADDRESS	CITY	STATE	ZIP CODE
SIGNATURE OF OWNER OR OFFICIAL CUSTODIAN		DATE	
PRINT NAME OF OWNER OR OFFICIAL CUSTODIAN	TITLE	TELEPHONE NUMBER WITH AREA CODE	

780-2122 11/10

SECTION 13 – Inspections

- A. At least every three years a department inspector will conduct an inspection of your water system. This is the minimum frequency required by federal regulations. During the inspections, staff will examine conditions relating to the construction, maintenance and operation of the public water system, and may take samples for analysis. If there are any deficiencies these will be noted and corrective actions may be recommended.

This is an excellent time for the owner or operator to ask any questions about compliance with regulations, sample collection, or operation and maintenance of the water system.

- B. In addition to the routine inspections, department staff may schedule a visit to investigate the cause of unsatisfactory water sample results.
- C. If there are deficiencies identified or improvements that need to be made to ensure the safety of the water system, you will be notified at the time of the inspection and receive a letter confirming the need for improvements. These inspections will cover the eight critical components of a public water system as defined by EPA. Not all components may apply your water system.
- D. The department is required to identify any significant deficiencies at the water systems. A significant deficiency is defined as: defects that include but are not limited to defects in design, operation, or maintenance, or a failure or malfunction of the sources, treatment, storage, or distribution system that the department determines are causing, or have potential for causing, the introduction of contamination into the water delivered to consumers. Under current regulations, Ground Water Rule significant deficiencies may include, but may not be limited to, the following:
- A. For the source:
 - Any improperly constructed, sealed or inadequately screened opening in the wellhead.
 - B. For treatment:
 - 1. Failure to perform and record the results of sufficient analyses to maintain control of treatment process or water quality.
 - 2. Systems required to provide 4-log virus inactivation or removal that do not meet disinfection concentration and detention time requirements.
 - 3. Systems that are required to disinfect that do not have standby redundant disinfection facilities.
 - C. For distribution systems:
 - 1. The existence of a known unprotected cross-connection.
 - 2. Widespread or persistent low pressure events as defined in 10 CSR 60-4.080(9).
 - 3. Submerged automatic air release valves or uncapped manual air release valves.
 - 4. Failure to properly disinfect new or newly repaired water mains.
 - D. For finished water storage:
 - 1. The existence of any unprotected, inadequately protected, or improperly constructed opening in a storage facility.
 - 2. Evidence that the water in the storage facility has been contaminated (for example, feathers or nesting materials in an overflow pipe or positive

- bacteria samples).
- E. For pumps or pump facilities and controls,
Repeated or persistent low pressures caused by pump or pump control problems or inadequate pump capacity.
- F. For monitoring, reporting, or data verification:
 - 1. Falsification of monitoring or reporting records.
 - 2. Failure to maintain system records as required by 10 CSR 60-9.010.
- G. For water system management or operations,
Failure to address significant deficiencies listed in the most recent inspection or sanitary survey report.
- H. For operator compliance:
 - 1. Lack of properly certified chief operator in responsible charge of the treatment facility as required under 10 CSR 60-14.010(4).
 - 2. Lack of properly certified chief operator in responsible charge of the distribution facility as required under 10 CSR 60-14.010(4).

When a significant deficiency is identified, and the department does not specify the corrective action to be taken, the water system then has 30 days from the date of notification to contact and consult with the department on the appropriate corrective action to take to remedy the deficiency. The system also has 120 days (from when it was notified of the significant deficiency) to either correct the deficiency or to be on schedule with a department-approved corrective action plan.

SECTION 14 – Record Keeping and Correspondence from the Department

- A. In addition to the sampling results mentioned in section 7 above, you will periodically receive correspondence from the department on a variety of issues. This correspondence is to inform you of changing requirements, sampling schedules, and other information you need to know as an owner or operator. If you have any questions call us. Most correspondence should be filed and permanently retained. A record retention guide follows.

RECORD MAINTENANCE

As required by
Missouri Safe Drinking Water Law and Public Drinking Water Regulations

“All suppliers of water to a public water system must retain records on their premises or at a convenient location near their premises...”

“When an investigation of any water supply, plant or methods used is undertaken by the Department of natural resources, the person in charge of the water supply shall furnish on demand to the Department such information as the rules and regulations promulgated require to determine the quality of the water being dispensed”

- ☐ Records of actions taken by the water system to correct violations of the Public Drinking Water regulations: **3 years.**
- ☐ Records of **Public Notices** issued by the water system due to violations, copies of **Consumer Confidence Reports**, and verification or certification forms that the public notice or CCR was issued or distributed as required: **3 years.**
- ☐ **Microbiological** sample analysis reports: **5 years.**
- ☐ Daily **Operational Monitoring reports**: **5 years.**
- ☐ **Turbidity** analysis reports: **5 years.**
- ☐ **Records concerning a variance or exemption**: at least **5 years** following the expiration of the variance or exemption.
- ☐ **Inspection reports and Sanitary Survey reports**: and any communications relating to inspections or sanitary surveys conducted by the system itself, by a private consultant, or by the Department, or federal agency: **10 years.**
- ☐ **Chemical** (IOC, SOC, VOC, etc) and **Radiological analysis** of water samples: **10 years.**
- ☐ **Lead and Copper**:
 - Original records of all sampling data and analysis, and reports, surveys, letters, evaluations, schedules and any other information required by the Lead and Copper regulations: **12 years.**
 - Records of violations of monitoring or testing procedures and the public notices for sampling, monitoring, MCL or other violations: **12 years.**
- ☐ **Surface Water Treatment Rules (LT-1 and LT-2)** Applies to Surface Water and Ground Water Under the Direct Influence (GWUDI) of surface water:
 - Results of individual filter monitoring: **3 years**
 - Disinfection Profiling Results (including raw data and analysis): **Indefinitely**
 - Disinfection Benchmarking (including raw data and analysis): **Indefinitely**
 - Results from the initial round and the second round of source water monitoring: **keep for 3 years** after either bin classification (filtered systems) or determination of the mean *Cryptosporidium* level (unfiltered systems).
 - Records of any notification to the state that they will not conduct source water monitoring because they are a filtering system with at least 5.5-log treatment; or a ground water system that will provide 3.0-log treatment: **3 years.**
 - Results of treatment monitoring associated with microbial toolbox options, and with uncovered finished water reservoirs: **3 years.**
- ☐ **Stage 2 Disinfection Byproducts Rule**:
 - Initial Distribution System Evaluation (IDSE) reports: **10 years**
 - Compliance monitoring results: **10 years**
 - Compliance monitoring plans: **As long as the corresponding monitoring occurs.** Keep the previous monitoring plan **for 10 years**

□ **Ground Water Rule.**

- Documentation of Corrective Actions taken by the water system: **10 years.**
- Documentation of notice to the public for a fecal positive source water sample, or a significant deficiency (10 CSR 60-4.025(4)(A)7): **3 years.**
- Records and reports of decisions of invalidation of all total coliform routine samples in the distribution system, and of fecal indicator-positive ground water source samples: **5 years.**
- **Consecutive systems:** documentation of notification to the wholesale system(s) of total-coliform positive samples that are not invalidated: **5 years.**

Compliance Monitoring: under the Ground Water Rule systems providing **4-Log treatment**, including wholesale systems, are required to perform daily compliance monitoring:

- Records of Department-specified minimum disinfectant residual for systems providing 4-log treatment: 10 years.

- Records of the lowest daily residual disinfectant concentration and records of the date and duration of any failure to maintain the Department-prescribed minimum residual disinfectant concentration for a period of more than four hours: **5 years.**
- Records of Department-specified compliance requirements for membrane filtration and of parameters specified by the Department for Department approved alternative treatment: **5 years.**
- Records of the Department specified compliance requirements for membrane filtration and parameters for alternative treatment: **5 years.**
- Records of the date and duration of any failure to meet the membrane operating, membrane integrity, or alternative treatment operating requirements: **5 years.**
- Records of the date and duration of any failure to meet the membrane operating, membrane integrity, or alternative treatment operating requirements for more than four hours: **5 years.**

Permanent water system records should include well construction information, including maintenance records, as built plans of storage and distribution lines; daily (or monthly) gallons pumped, draw-down and monthly pump rate, and consumer complaints.

For most small systems such as mobile home parks and subdivisions, a portable file folder box available at any office supply store should work well to keep the water system files organized. At a minimum you should have one file folder for:

- monthly bacteriological sample reports,
- chemical sample reports,
- inspection reports and any violations and public notices made,
- any general correspondence from the Department,
- the annual Consumer Confidence Report (community systems only);
- monthly operating reports such as gallons pumped and chlorine readings, well maintenance reports that your operator maintains.

System maintenance records, original plans, equipment warranties and equipment information should be kept and organized as needed.

Using the information above, you will know when it is safe to purge excess reports from your file cabinet.

SECTION 15 – Well information form and Contacts List

- A. We suggest that you use this page to record information about your well, to record maintenance done on the well.

Water Well Details

Well Registration #		Well Diameter		Total Depth:	
Aquifer Name					
SURFACE CASING	Material		Diameter		Depth
PRIMARY CASING	Material		Diameter		Depth
DROP PIPE (RISER PIPE)	Material			Diameter	
Check Valve(s)		<input type="checkbox"/> Yes <input type="checkbox"/> NO		Number	
ELECTRICAL					
Volts	Hertz	Phase	Lightning Protection <input type="checkbox"/> Yes <input type="checkbox"/> NO		
PUMP					
Manufacturer:		Model		Horsepower	
Capacity (gallons per minute):		at _____ TDH		Pump Depth:	
SCREEN (Enter N/A if there is no screen)					
Manufacturer/Type				Material	

- B. We suggest that you use the following page to keep the name and telephone number of well maintenance services you have used.

WELL INFORMATION AND CONTINGENCY CONTACT PLAN

The following information may be useful if it is necessary to perform maintenance on the well or water storage system. This is especially true if the usual well maintenance business happened to be unavailable, or if the owner or manager of the water system was unavailable. Having this information readily available may make the difference between being back into operation in a short time, versus having customers out of water for several days. For a business it may mean shutting down for several days. For a mobile home park, if you sell the business this information will be valuable to the new owner.

Names and phone numbers of three facility personnel that have the authority to implement repair practices in an emergency situation, such as a pump outage, well and distribution system shock chlorination, water line break or leak, etc:

- 1 _____
- 2 _____
- 3 _____

Name and phone number of well service business. List a second choice if possible.

Location of well. Sometimes wells are located in strange places, such as in the basement, under a paved driveway, etc. Give as much detail as possible.

Name and telephone of plumber or other necessary service personnel.

List any available information on well such as total depth of well, date pump and drop pipe was installed, size of pump, date well was drilled, depth of casing, name of company that originally drilled well, etc.

If there is any other emergency information, such as a connection with another water system that can be activated in case of need, give details here such as contact person and telephone.

SECTION 16 – Emergency Operating Plans

Community public water systems are required must develop an Emergency Operating Plan to ensure continuous water service under emergency conditions. The plan should include designation of a coordinator and key personnel to be on call under emergency conditions, a list of personnel authorized to expend funds under emergency conditions, an inventory of emergency equipment and written emergency procedures. Department regional office staff can provide guidance documents and assist you in developing or updating an Emergency Operating Plan for your water system. You can also order the “Public Water Supply Model Emergency Operation Plan Package, Booklet, Publication 175” from the department’s Public Drinking Water Branch at 573-751-5331, or download at: www.dnr.mo.gov/env/wpp/eop/index.html

SECTION 17 – Abandoned wells

- A. If a well exists that is not in use and there are no plans to use it in the near future, then this is referred to as an abandoned well. A well may be abandoned for a variety of reasons, such as low production and poor water quality. Abandoned wells usually deteriorate because of lack of maintenance and pose a hazard to other wells in the area. When the casing corrodes and the well is not maintained, contamination can enter the well and cause other nearby wells in use to be ruined. Department regulations require that a well that has not been in use for two years be plugged according to department guidelines. For information on how to properly close an abandoned well, contact the department’s regional office, or Geological Survey division at 573-368-2196. The department’s publication, “Plugging your abandoned well, Pub 2281” is available online at dnr.mo.gov/pubs/index.html#wellhead.

SECTION 18 – Additional Information

Statewide List of Public Health Laboratory Courier Stops

The following link gives the pickup locations for the courier service operated by the Missouri Department of Health and Senior Services.

www.dnr.mo.gov/env/wpp/pdwb/courier-list.pdf

Courier pick up times are shown in the table. Exact times may vary day to day depending on weather and traffic. You should contact the location to confirm its normal pick-up time, but remember: changes in the driver's schedule can occur without notice.

In order to meet the 30-hour holding time, the sample must be collected and delivered to the pick-up location before the courier arrives.

Water samples must be in their shipping box, sealed, and with the shipping label affixed with your return address. Most locations will not accept loose bottles or unsealed boxes.

Questions regarding courier services should be directed to 573-751-4830.

Additional Sources of Information

The Missouri Department of Natural Resources' website, dnr.mo.gov, contains links to various department programs, forms, publications, laws and regulations.

The Public Drinking Water Branch is part of the department's Water Protection Program, and has a website at dnr.mo.gov/env/wpp/dw-index.htm. Links to various sources of information useful to owners of public water systems are made available by the Public Drinking Water Branch.

One tool in particular, Drinking Water Watch located at dnr.mo.gov/DWW, can be used to obtain basic facts regarding any active public water system in Missouri.

Commonly Asked Questions:

Q. Why do I have to do all this sampling and other stuff?

A. Federal and state laws require that anyone who owns or operates a water system that serves water to the public meet certain minimum requirements. One of the most important requirements is that sampling be done to ensure water served to the public meets minimum standards.

Q. Has anyone ever benefited from all this expensive sampling?

A. Yes. The awareness that water can be a carrier of disease was a great step toward improving public health. Waterborne illness is less common than a century ago but there are still occasionally major incidents. Locally, there are still cases where water is found to be contaminated with E. coli, the class of bacteria that makes the news when contaminated food or water causes people to get sick and sometimes die. Chemical contamination is increasing. Municipalities in Camden and Franklin counties have been forced to abandon wells because of contamination from local factories.

Q. Why do you say I own a public water system? I just have a small resort.

A. Laws and regulations define public water systems in several ways. If a system has 15 or more living units (mobile homes, apartments, homes, etc) or 25 or more persons using the water on a year-round basis, then it is a public water system. Also if it serves 25 or more of the same persons over six months of the year (factories, schools, etc) it is a public water system. And if it has 15 or more service connections (motel units, etc) or serves water or uses it for food preparation to 25 or more individuals for 60 or more days each year, it is a public water system. By these definitions, even motels and restaurants open only during the summer are public water systems.

Q. What do you mean when you say I am an “operator”?

A. An owner is the person who legally owns the water system. If you do not own the water system but lease it as part of a business, or if you are the person that is responsible for taking care of the water system, or you are the responsible person for the business that includes the water system, then you are referred to as the operator. An operator takes samples, is responsible for repairs, and is generally the person in charge of the water system.

Q. How can I avoid being a public water system?

A. There are two ways. One is to serve so few people or to be open for such a short time that you do not meet the definitions listed above. The other is to connect to another public water system such as a city or water district. The city or district then is the public water system and has all of the responsibility for sampling and other requirements and you are just a customer.

Q. What happens if I refuse to take part in the program?

A. The U.S. Environmental Protection Agency and the Missouri Attorney General have the statutory authority to take legal action against owners and operators that do not comply with requirements.

Q. What does this cost me?

A. There is an annual laboratory fee for private community water systems. Small community groundwater systems and secondary water systems, with fewer than 4,100 service connections will be charged \$200. Water systems with 4,100 to 7,599 service connections will be charged \$300, and systems with 7,600 or more service connections and primary surface water systems will be charged \$500.

Q. This whole thing is new to me. Is there anyone that can help me understand it all?

A. Yes. Department of Natural Resources staff can assist you in understanding the requirements and guide you through the regulatory process.

Q. I am going to sell my business. Is there anything I should do?

A. Yes. First, inform the Department of Natural Resources. You should inform the new owner that there are obligations concerning the water system. A change of ownership form should be sent to the department. Do not send a note with one of your routine sample bottles.

Q. What do I do with all this correspondence I receive from the department?

A. First, open and carefully read everything. This may be information about your sampling schedule, about new requirements, about your certification, and other things you should know. Then establish a permanent file and keep it.

COMMONLY MADE MISTAKES

1. Getting in a hurry when taking the monthly sample and not carefully disinfecting and flushing the sample tap.
2. Not filling out the sample form completely or correctly.
3. Collecting a sample on Friday, a holiday, or just before a holiday.
4. Thinking that because a special sample was collected that the routine sample for the month can be skipped.
5. Not carefully reading all correspondence from the department.
6. Not collecting the chemical samples quickly and missing the scheduled UPS pickup time.
7. Not routinely and frequently checking the well, pressure tanks, storage tank overflow, and other parts of the system to be sure they are in good working order.
8. For chlorinated systems, not performing routine maintenance on a daily or as needed basis.
9. Collecting repeat samples does not mean that you do not have to collect routine samples for that month. For example: you collected a routine sample on Sept. 30 that was coliform positive, you will be required to collect four repeats in early October as well as five routine samples before the end of October.



MISSOURI DEPARTMENT OF NATURAL RESOURCES

REGIONAL AND SATELLITE OFFICES

Kansas City Area

- **Kansas City Regional Office**
500 NE Colbern Rd.
Lee's Summit, MO 64086-4710
816-251-0700
FAX: 816-622-7044
- **Northwest Missouri Satellite Office**
Northwest Missouri State University
Environmental Services Building,
800 University Dr.
Maryville, MO 64468-8015
860-562-1878 or 860-562-1877
FAX: 860-562-1878
- **Truman Lake Satellite Office**
Harry S Truman State Park
28761 State Park Road West
Warsaw, MO 65355
860-438-3039
FAX: 860-438-5271

Southwest Area

- **Southwest Regional Office**
2040 W. Woodland
Springfield, MO 65807-5912
417-891-4300
FAX: 417-891-4399
- **Lake of the Ozarks Satellite Office**
Lake of the Ozarks Satellite Office
5570 Osage Beach Parkway
Osage Beach, MO 65065
573-348-2442
FAX: 573-348-2568
- **Newton County Satellite Office**
Crowder College
601 Laclede, Smith Hall, Room 201
Neosho, MO 64850
417-455-5180 or 417-455-5158
FAX: 417-455-5157

Northeast Area

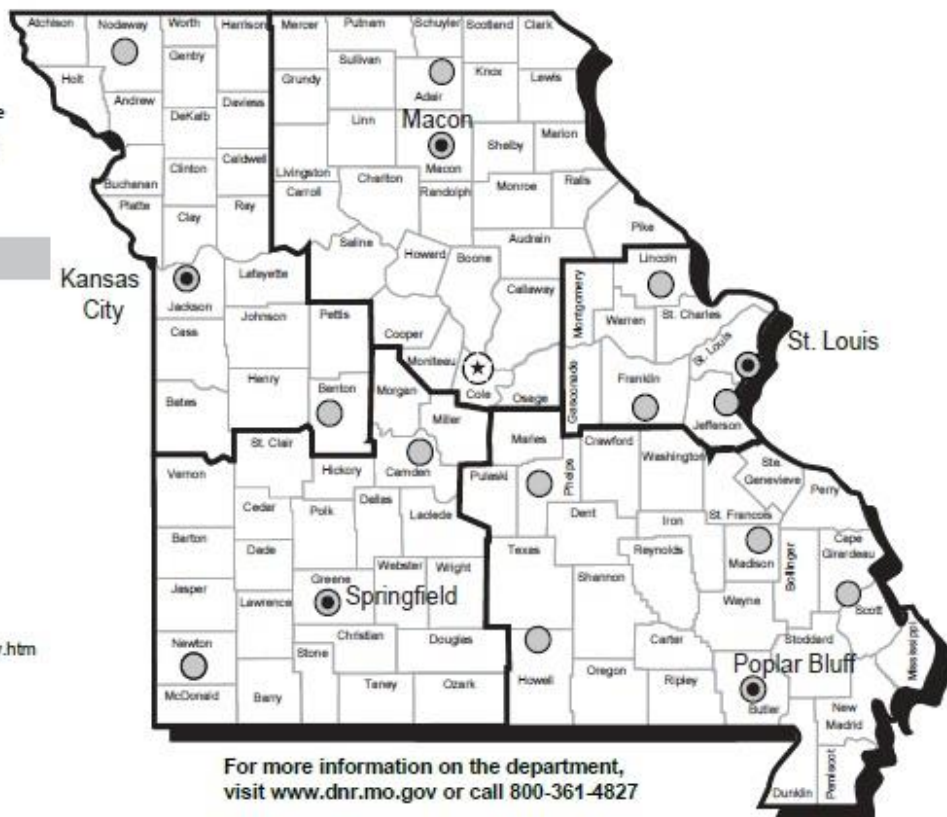
- **Northeast Regional Office**
1709 Prospect Drive
Macon, MO 63552-2802
660-385-8000
FAX: 660-385-8090
- **Kirkville Satellite Office**
Truman State University
Magruder Hall, Room 3088
100 E. Normal St.
Kirkville, MO 63501
660-785-4610
- ★ **Department Central Offices**
P.O. Box 176
Jefferson City, MO 65102-0176
573-751-3443
www.dnr.mo.gov/shared/map-jeffcity.htm

St. Louis Area

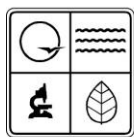
- **St. Louis Regional Office**
7545 S. Lindbergh, Ste 210
St. Louis, MO 63125
314-416-2960
FAX: 314-416-2970
- **Franklin County Satellite Office**
Meramec State Park
Hwy. 185 S.
Sullivan, MO 63080
573-860-4308
FAX: 573-468-5051
- **Jefferson County Satellite Office**
Eastern District Parks Office
Hwy. 61
Festus, MO 63028
636-931-5200
FAX: 636-931-5204
- **Lincoln County Satellite Office**
Cuivre River State Park
678 State Rt. 147
Troy, MO 63379
636-528-4779
FAX: 636-528-5817

Southeast Area

- **Southeast Regional Office**
2155 North Westwood Blvd.
Poplar Bluff, MO 63901
573-840-9750
FAX: 573-840-9754
- **Cape Girardeau County Satellite Office**
2007 Southern Expressway
Cape Girardeau, MO 63701
573-651-3008 (phone and FAX)
- **Howell County Satellite Office**
700 W. Main St.
Willow Springs, MO 65793
417-469-0025 (phone and FAX)
- **Madison County Satellite Office**
120 W. Main St.
Fredericktown, MO 63645
573-783-2385
FAX: 573-783-6294
- **Rolla Satellite Office**
111 Fairgrounds Rd.
Rolla, MO 65402
573-368-3625
FAX: 573-368-3912



For more information on the department,
visit www.dnr.mo.gov or call 800-361-4827



Well and Water System Disinfection

A Water Protection Program Technical Guidance Document

This brochure contains a step-by-step procedure for performing a simple disinfection of wells and water (plumbing) systems using chlorine bleach (sodium hypochlorite). Please read the entire brochure before starting any well disinfection. If you are not comfortable with this procedure, or for complex water systems or severe contamination problems, a licensed well contractor or pump installer can disinfect your well and water system for you.

What is Disinfection?

Contaminated drinking water may contain harmful bacteria, viruses, or other microorganisms that can make you sick. Disinfection is one process of killing or inactivating microorganisms to make water safe for drinking. Disinfection can also eliminate nuisance bacteria that can cause unpleasant tastes and odors.

What Causes Well and Water System Contamination?

A well or water system may become contaminated with harmful bacteria and other organisms when the well or plumbing is open to the environment during construction, repair, or routine maintenance. A well may also become contaminated if the well casing is deteriorated or damaged, if the pitless adapter is deteriorated, or if the well is flooded. Contamination problems can also be caused by improper plumbing connections between water treatment devices and wastewater piping, between the potable water plumbing and heating/cooling systems, or other cross connections.

How Often Should a Well be Tested?

Typically, a well should be tested at least once a month for “coliform bacteria,” or whenever there are changes in the water’s taste, odor, or appearance. The coliform bacteria test analyzes for a number of bacterial species. Most of these are not harmful, but a few are. Their presence indicates that surface contamination has found its way into the well, and disease organisms may also be present. The presence of *E. coli* or fecal coliform represents a more serious health risk and any water use should be strictly limited to nonpotable uses (not used for drinking, cooking, or human contact).

Water samples should be analyzed for coliform bacteria by a certified laboratory.

When Should a Well Be Disinfected?

Well disinfection should be performed:

- When water testing indicates the presence of coliform bacteria.
- When the well has been near flood waters.
- After installation or repair of plumbing pipes and fixtures, e.g., softeners, faucets, and filters.
- After well or pump repairs.
- When iron or sulfur bacteria reduce the water supply capacity of the well or cause taste and odor problems.
- During startup of seasonal wells where plumbing, wells, or pumps have been disconnected or the water system has otherwise been drained or opened.

Well disinfection will **not** solve the following problems:

- When contamination is originating from a continuous source such as a septic system or an animal feedlot.
- When a well or plumbing system is improperly constructed, located, or damaged and in need of repair (disinfection should follow repair work).
- If the contaminant is nitrate, arsenic, fuel, pesticides, or other chemicals.

Safety Precautions

ELECTRICAL SAFETY

- **EXTREME CAUTION** is advised when disinfecting a well, as you often will be working with electricity and water. Electricity can kill you. **If you are not acquainted with working with electricity, seek professional advice.** Your safety precautions should include:
 - Turn off the pump circuit breaker before removing the well cap and while working on the well.
 - While the breaker is off, examine for chafed wire insulation or missing wire nuts and repair as necessary.
 - Wear rubber soled shoes or boots, preferably waterproof.



CHEMICAL SAFETY

- Severe eye damage may result from contact with bleach or chlorine solution.
- Always follow the manufacturer's use and safety directions.
- Avoid eye and skin contact. Wear protective goggles or a face shield and rubber gloves when working with the bleach or chlorine solution. Handle and dispose of chlorine with care.
- Do not mix chlorine with other chemicals, as mixing chemicals may form harmful gases.
- Do not leave bleach bottles lying around – ingestion of bleach is the most common cause of poisoning of children in the United States.

RESPIRATORY SAFETY

- Underground well pits pose an extreme hazard, as they frequently contain a build-up of toxic gases or simply lack enough oxygen to sustain life. Access is limited, making quick escape difficult.
- If the well is located in an underground well pit, **DO NOT ENTER IT**. Death can occur even in a shallow well pit.
- Leave disinfection of wells in pits to professional, licensed well contractors, or pump installers.
- Harmful gases may be generated during disinfection. Avoid inhalation of fumes and make certain that enclosed spaces such as well rooms have adequate ventilation before starting disinfection.

Procedure for Disinfection of the Well and Water System

The following procedure is for a well that has a submersible pump with either a removable well cap or a well seal with a threaded plug in it. See STEP 4 to determine whether you have a well cap or a well seal. If the well has a sanitary seal, this procedure can only be attempted if a removable threaded plug in the sanitary seal allows access into the well. If your well has a type of pump other than a submersible pump, is located in a well pit, is a flowing well, or has a sanitary seal without a threaded plug, you should contact the State for advice or have your well disinfected by a licensed well contractor or licensed pump installer.

STEP 1 - Isolate critical water system components



► **Bypass water softeners and other water system components, such as the dishwasher and the washing machine, that may be damaged by chlorine prior to initiating this well disinfection procedure.**

Since water softeners, water filters, and other water treatment or water using devices may harbor organisms, it will be necessary to separately disinfect the softener and other devices. Water treatment devices should be disinfected separately according to the information provided by the manufacturer or water conditioning contractor. If this information is not available, see the section on disinfecting water treatment equipment and water using devices at the end of this fact sheet.

► **Turn off and drain the water heater.** Use caution to avoid scalds or burns. Follow procedures as described by the manufacturer or plumber.

STEP 2 - Mixing a chlorine solution

Table for a 50 mg/L chlorine residual
Using 5.25%-6.0% Liquid Laundry Bleach (Unscented)

Well Casing Diameter

Depth of Water in well	4 inch	6 inch	8 inch	10 inch	12 inch
100 ft.	1 cup	2.5 cups	1 qt.	.50 gal	.75 gal
200 ft.	2 cups	5 cups	2 qt.	1 gal	1.50 gal
300 ft.	3 cups	7.50 cups	3 qt.	1.50 gal	2.25 gal
400 ft.	4 cups	10 cups	4 qt.	2 gal	3 gal
500 ft.	5 cups	12.5 cups	5 qt.	2.5 gal	3.75 gal
600 ft.	6 cups	15 cups	6 qt.	3 gal	4.25 gal

Chlorine dose will range from 48 mg/L to 64 mg/L

This table indicates the amount of laundry bleach (6.0 percent sodium hypochlorite or 5.7 percent available chlorine) that should be used for well disinfection. Sodium hypochlorite is the disinfectant found in laundry bleach and is the recommended product for well disinfection. Since bleach loses its disinfecting capacity over time it is important that a fresh container be used. Do not use laundry bleach that contains any fragrance or other additive.

► **Place a large clean bucket near the well. Add 1 gallon of water and the amount of bleach indicated in the table to the left and mix thoroughly.**

For wells greater than 100 feet deep or with well casing diameters greater than 6 inches, mix the bleach with 2 gallons of water. For wells greater than 200 feet deep or with well casing diameters greater than 6 inches, increase the amount of bleach proportionately. After this solution is poured into the well, it will provide a chlorine concentration of at least 50 parts per million.

In situations where an initial disinfection has not worked, where there is considerable iron or other solids in the well, or where there is a significant nuisance bacteria problem, a more concentrated chlorine solution may be used. Multiply the quantities of chlorine listed in the table above by four and mix with 4 gallons of water (for example, a 4-inch diameter well that is 51-100 feet deep would need 4 cups of bleach mixed with 4 gallons of water). This will provide a chlorine concentration of at least 200 parts per million in the well and water system. **NOTE: Too strong a chlorine solution will reduce the effectiveness of disinfection.** If the chlorine concentration greatly exceeds 200 parts per million, it can actually make the water too alkaline and reduce the effectiveness of the disinfection process.

WARNING: If your well has not been disinfected for many years, it may have considerable scale built up. Disinfecting with a strong chlorine solution can dislodge this scale and plug or

damage your pump, and/or cause problems elsewhere in the plumbing system. You may wish to begin with a weaker solution of chlorine. If the water runs red or brown, pump it out on the ground surface without recirculating it back into the well as described in STEP 6. Once the color gets lighter, mix a new chlorine solution batch as described in STEP 2 and begin the process again.

STEP 3 - Electrical safety



► **Turn off electrical power to the pump by turning off the circuit breaker or unscrewing the fuse.** If the breaker or fuse box has a “lockout” hasp to prevent someone from accidentally turning on the water pump circuit breaker, use it. Power should not be turned back on until STEP 6 or after the chlorine solution has been placed in the well.

STEP 4 – Opening the well

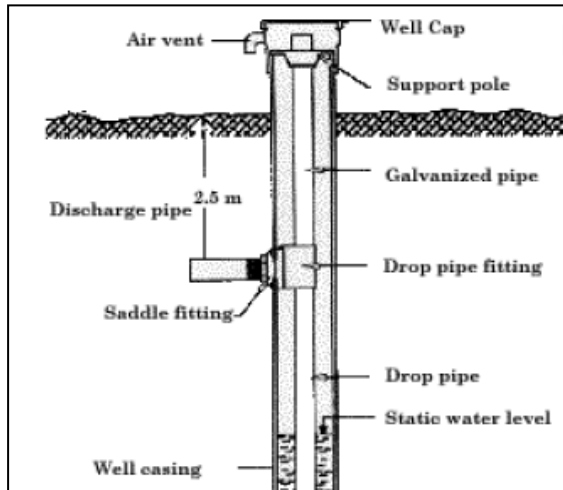


Do not place well components directly on the ground. Determine whether your well has a well cap or a well seal. A well cap overlaps the top of the well casing and is held in place with bolts or set screws. A sanitary seal fits tightly within the very top of the well casing. Only a professional should remove a sanitary seal. If a well has a well cap, the discharge pipe from the well is usually underground. If the well has a well seal, the discharge pipe from the well is usually through the top of the well. If you are unsure as to whether your well has a well cap or a well seal, you should seek professional advice.



With electrical power off, open the well.

► **If your well has a well cap, remove the bolts along the outside edge of the top of the well cap for newer models, or loosen the set screws on the side of the cap for older models and lift off the cap. Gently lift the wires/wire nuts out and pull to the side. Do not pull on the release cable or pull the pipe for the pitless adapter and pump. Check for damaged wires/wire nuts. Be careful not to loosen any connections.**



Wells with pitless units have the casing extending up above the ground surface. Wells which have pitless adapter units have a cap that sits down over the well casing (sometimes they have three little set screws on the side of the cap to secure it).

If your water pipe(s) and electrical wires come out of a metal plate on top of the well, which has four bolts in it, you have what is called a *sanitary seal* (see figure below).

The pump and pipe hang on a sanitary seal, so do not loosen the bolts and raise this unless you know what you are doing. Instead you can access the well through the vent pipe.



► If your well has a well seal with a threaded plug, you can remove the plug and pour the chlorine solution through the hole. Or you can unscrew the breather vent and use this opening. Be sure to replace the vent securely after the disinfection process. If there is no threaded plug in the well seal, you should have the well disinfected by a licensed well contractor or licensed pump installer. The well seal has bolts that compress the seal. Loosening the bolts too far may cause a portion of the seal or the pump to fall into the well.

Do not remove or loosen the bolts. Do not remove the well seal.

STEP 5 - Adding chlorine to the well



► Pour the mixture into the well and avoid spilling on any wire connections. A funnel should be used for pouring the chlorine solution into small openings.

- Be careful not to splash/spill the concentrated solution.
- Wear gloves and goggles.
- Do not use a siphon.

STEP 6 - Recirculating chlorinated water



Recirculating the chlorinated water mixes the water column thoroughly and distributes the chlorine. It helps to wash down the inside sidewalls of the well casing, pump wires, and drop pipe.

► **Turn on the power to the pump.**

► **Connect a clean garden hose to a nearby yard hydrant or an outside faucet. Run the water out of the hose in an area away from the well for approximately 10 minutes until the water runs clear.**

You may notice that the water coming from the garden hose turns red, yellow, or brown. This is due to the chlorinated water precipitating iron from the water. The chlorinated water may also dislodge scale or rust from the sides of the well casing. Scale, iron, manganese, or other precipitated minerals may form when the chlorine is added to the system. These solids can cause clogging of faucet aerators, valves, water solenoids, and equipment using filters. Run the water out on the ground until the water runs clear. Additional chlorine solution may need to be added to the well. **Do not start recycling water down the well until the water from the hose is clear.**

► When the water coming from the garden hose is relatively clear, turn the water off, place the garden hose into the top of the well casing and run water into the well. After the chlorine smell is first detected from the garden hose, recirculate the water back into the well for about two hours. It is best to surge the well during the process by starting and stopping the pump to help mix the chlorine deeper into the well. You can use chlorine test papers, such as those commonly used to check the chlorine in swimming pools, to provide a visual indication that chlorine is present.

► Turn off the power to the pump. Remove the garden hose from the well casing and replace the well cap or threaded plug in the well seal.

Do not run discolored water through the household plumbing, and do not run it into a septic system. Since a strong chlorine solution may harm vegetation, dispose of the chlorinated water away from sensitive plants. Do not discharge water into a lake or stream as this may harm aquatic life.

STEP 7 - Bringing chlorinated water to each faucet



► Turn on the power to the pump. Run chlorinated water through the entire plumbing system by running water to each fixture* one at a time until you smell bleach (or use chlorine test papers available at pool supply businesses) and then close the fixture. Do this for each fixture, including:

- Cold and hot water faucets.
- Toilets and shower/bath fixtures.
- Any outside faucets or yard hydrants

*Faucet aerators may need to be removed if clogging occurs from precipitated iron or loosened scale.

► Leave the chlorinated water in the system a minimum of two hours, and preferably at least six hours or overnight.

WARNING: Chlorine can cause eye damage and skin irritation. In addition to not using the water for consumptive purposes, all potential water users need to be warned that a potentially dangerous concentration of chlorine is in the water system. Do not shower/bathe with water containing high levels of chlorine. You may wish to place a pail or bag over each faucet as a reminder.

STEP 8 - Removing the chlorinated water

► Run a garden hose from an outside faucet or yard hydrant to flush the chlorine out of the system. It can take 30 minutes to 24 hours or more to flush all of the chlorine from the well.

► Once the chlorine is gone from the well, open up each fixture one at a time until the chlorine smell is no longer present. This will purge the remaining chlorine from the water system. It should take just a few minutes to flush out the chlorine from the cold water lines. The hot water faucets will have to be run longer. In some cases, it may be quicker to drain the water heater(s) again. The small amount of chlorinated water flushed from the water pipes can be run into a septic tank.

Do not run the chlorinated water into your septic system as this can kill many of the beneficial bacteria in the system. Also, the amount of water required to flush the well may hydraulically overload and damage the septic system. Since a strong chlorine solution may harm vegetation, dispose of the chlorinated water away from sensitive plants. Do not discharge water into a lake or stream as this may harm aquatic life.

STEP 9 – Reconnecting water softeners and other water treatment devices

- ▶ Return bypass valves to “on” or “service” position after following the manufacturer’s directions to disinfect these devices.
- ▶ Refill the water heater if applicable.
- ▶ Start the water heater.

STEP 10 – Testing your water



Make sure the chlorine has been removed from the water system. It is recommended that a sample be collected a couple days after the well is disinfected. **Do not use the water for drinking, cooking, or food preparation until it tests free of coliform bacteria.** Follow the procedure for collecting a water sample given on the first page of this fact sheet.

Procedure for Disinfection of Water Softeners, Water Treatment Equipment, and Water Using Devices

Water softeners, water treatment equipment, and water using devices, such as dishwashers and washing machines, may be damaged by excessive amounts of chlorine. However, the softener and other devices should be disinfected when there are bacteria problems in the plumbing. After step 8, follow the manufacturer’s instructions for disinfecting the particular unit you have. If the disinfection information is unavailable, the following steps can be used, as recommended by the Water Quality Association, a not-for-profit international trade organization representing the household, commercial, industrial, and small community water treatment industry. For further questions regarding this section, contact the association at 630-505-0160 or visit the website at www.wqa.org.



1. Water Softeners

- ▶ Keep unit on “bypass” until chlorine is flushed out of the system. To thoroughly disinfect the softener after all the chlorine is flushed from the system, add one-half cup bleach to the softener’s brine tank and run the unit through a regeneration cycle immediately.

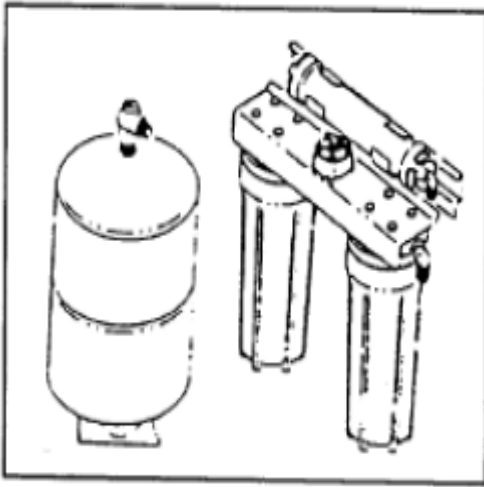


2. Water Filters

► For carbon filters and other cartridge water filters, remove and discard the old filter cartridge. Wash the sump and head with laundry detergent and bleach and rinse. Insert a new cartridge filter.

► For whole-house carbon tank filters or a water softener that contains carbon, empty the entire media bed. Thoroughly clean the empty unit inside and out with a laundry bleach and water solution. Re-bed the unit using new carbon or other media/carbon mix.

3. Reverse Osmosis (RO) Systems



► Turn off the water supply to the RO unit and open the RO faucet to relieve pressure and drain the RO storage tank.

► Remove and discard the pre- and post-filters and remove the RO membrane element. Clean and disinfect the filter sumps, the filter heads, and the RO membrane housing and end caps.

► Fill the first prefilter sump with water to within about 2 inches from the top and add 1 ounce (2 tablespoon's or 6 teaspoon's) of unscented laundry bleach (6.0 percent sodium hypochlorite or 5.7 percent available chlorine); carefully reassemble this first prefilter with the chlorine/water mixture but without its filter cartridge element in place.

► Reassemble all the remaining housings without their membrane element and filter cartridge elements in place.

► Open the water supply to the RO. Open the RO faucet and allow water to run until you can begin to smell the chlorine bleach. (If no chlorine bleach smell can be obtained, go back to bullet point three and increase the amount of laundry bleach added until a residual can be maintained throughout the system.)

► Close the RO faucet and allow the storage tank to fill and then remain full for 25-30 minutes.

► Open the RO faucet again and leave it open until the entire chlorine bleach smell is gone. Let the accumulated water in the RO storage tank drain completely.

► Turn off the water supply to the RO. Close the RO faucet after all the pressure has been relieved and the water flow stops.

► Install all new pre- and post-filter elements, using careful aseptic techniques so as to not re-contaminate the RO system.

► Reinstall the RO membrane element in its housing. Fill the membrane element housing with water and 1 milliliter (20 drops) of laundry bleach. Reassemble this membrane element, chlorinated water, and housing unit.

****CAUTION: High levels of chlorine over an extended period of time can degrade polyamide thin film composite (TFC) RO membranes, although significant degradations should not occur in these specified few minutes of chlorine contact time.***

► Immediately reopen the water supply to the RO system and reopen the RO faucet. Let water drip from the RO faucet until the chlorine bleach smell has dissipated.

► Finally, close the RO faucet, let the storage tank completely refill, and discard the first full tank of water following the completion of this procedure.

Follow-up

It is a good idea to double check that the water is safe. After receiving the results of a satisfactory sample analysis, take another water sample approximately 30 days after the first sample and have the water retested. If coliform bacteria are detected again, re-disinfect the well using the same procedure.

If the well and water system have not been disinfected for many years, they may need to be disinfected more than once. If multiple disinfections are unsuccessful, and coliform bacteria persist, contact a licensed well contractor or pump installer who can utilize special techniques and equipment to disinfect the well. The well may have to be physically cleaned or treated with other chemicals.

The owner, well contractor, or pump installer should also inspect the well for any damage. Well casings can be cracked or well caps loosened if struck by vehicles or by garden or farming equipment. It is essential that any plumbing or well defects that could allow surface water or other contaminants to enter the well be corrected. If the well cannot be successfully disinfected, the source of the contamination should be determined if possible. If the source cannot be corrected or removed, the well may need to be sealed and a new well drilled.

Appendix B: Disinfection of Water Storage Tanks

Introduction

The following provides guidance on the disinfection of water storage tanks. Seasonal water systems, those that shut down for part of the years such as campgrounds and schools, should disinfect and flush the system prior to opening for the new season. For others the water tower or tank may have been contaminated. This could occur if the well has been contaminated, and the contaminated water was then pumped to the storage tank. Most often for towers and standpipes the roof vent has been damaged or the roof hatch does not adequately seal. If this happens insects or birds can enter and contaminate the tank. If the tank is filled so that it overflows and feathers, grass and other nesting materials, or insects are found in the overflow then the storage tank has been compromised. You need to contact a professional inspection and cleaning company. Please refer to “Microbial Contamination of Water Storage Tanks, Fact Sheet--PUB172” and the “Inspection of Water Storage Facilities, Technical Bulletin--PUB2112” for more information. These are available on the department’s website at: dnr.mo.gov/pubs/index.html#DrinkingWater.

Following any construction, repairs, painting, or other maintenance all finished water storage tanks must be disinfected according to the guidance in the latest edition of the AWWA Standard for Disinfection of Water-Storage Facilities, AWWA C652. Following the disinfection and flushing of the tank at least one sample should be collected and be coliform free before the facility is placed into operation. The disposal of chlorinated water from the tank must be in accordance with Missouri requirements to protect aquatic life. Chlorinated water is toxic to most aquatic life and improper flushing and disposal has caused numerous fish kills in Missouri. Contact your local department regional office for guidance on the proper discharge and disposal of chlorinated water.

For routine or seasonal disinfection of water storage tanks please follow the following guidelines.

Table 1: Amount of chlorine required per each 1,000 gallons of water

Desired Chlorine Dose <i>mg/L</i>	Sodium Hypochlorite (Liquid)			Calcium Hypochlorite Powder or Tablets (by weight)
	6% available chlorine (bleach)	10% available chlorine	15% available chlorine	65-70% Available Chlorine
5 mg/L	11 ounces	6.5-oz	4-oz	1-oz (0.06 lbs.)
10 mg/L	22 ounces	13-oz	9-oz	2-oz (0.12 lbs.)
20 mg/L	43-oz (1/3 gal.)	26-oz (0.2 gal.)	17-oz (1 pint + 1-oz)	4-oz (0.25 lbs.)
50 mg/L	102-ounces (0.8 gal.)	64-oz (2-Qt)	42-oz (1/3 gallon)	10-oz (0.6 lbs.)
200 mg/L	3-gal. + 2 pints	2 gallons	1.3 gallons	2.5 lbs.

Please Note: the following methods require the use of some safety equipment and protective clothing. It is often better to hire a professional who has the experience and equipment to safely and effectively disinfect a water tower or tank. Contact the department for a list of known water tank and tower service companies.

Chlorination Method 1: For storage units not in use (season has not started) or can be taken out of service.

Calculate the chlorine needed to provide at least a 10 mg/L free chlorine residual for the water storage unit. If the tower or tank is full lower the water to about half. Add the chlorine and fill the water-storage facility until it just overflows. If using calcium hypochlorite wait at least two hours for the powder to dissolve before filling the tank. Hold the water for at least six hours. At this time outside faucets in buildings can be opened to draw the chlorinated water through the water main and to the buildings or campsites. If this lowers the water in the tank add water until it just overflows. Check the chlorine residual. If it has dropped significantly add some more chlorine to bring the residual up to the desired calculated dose. A higher chlorine dose can be held for a shorter time.

After the holding time the tank can be slowly drained and then refilled. When the chlorine level is down to 4 mg/L it is safe to use, no additional flushing is needed. Open the faucets out in the distribution and flush the high chlorine water out. At 4 mg/L there may be a noticeable chlorine odor but it is safe for consumption.

Chlorination Method 2: Leave water tower empty. Prepare a 50 mg/L chlorine solution. Spray the entire inside and floor of the water tower and let sit for minimum of 1 hour. Refill the tank until it just overflows. **Caution: This method involves confined space entry and requires respiratory safety equipment** and should only be used by trained professionals.

Chlorination Method 3: For storage units that cannot be taken out of service.

Calculate the chlorine needed to provide a 4 mg/L to 5 mg/L free chlorine residual for the water storage unit. If using calcium hypochlorite dissolve the powder first to obtain a solution. Lower the water level to about half or to the level that will not cause low pressures in the water system, and add the chlorine solution. Refill the tank until it just overflows. The normal use will draw the chlorinated water out through the distribution system. Check the chlorine residual daily, and add chlorine to the tank as needed to maintain a 2 mg/L to 3 mg/L residual for at least three days.

Caution: Please read and follow Appendix C: Discharge of Chlorinated Water, Best Management Practices. If chlorinated water enters a stream, river or lake and a fish kill occurs, the water system may be fined by the departments of conservation and natural resources. Please contact a regional office for assistance with disinfecting tanks and towers, and the discharge of the chlorinated water.

Bacteriological Sampling and Testing

After disinfection collect at least two bacteriological samples (Special samples). Satisfactory results must be obtained before the storage unit is returned to service. If a chlorine residual remained in the water when the samples were taken the unit can be returned to service but collect an additional Special sample each week for three weeks to ensure no contamination remains or returns.

Appendix C:

DISCHARGING CHLORINATED WATER BEST MANAGEMENT PRACTICES

The objective of disinfection and flushing programs is to maintain a high level of water quality delivered to customers. The Department of Natural Resources Public Drinking Water Branch encourages public water systems to conduct routine water main flushing, particularly on those water mains that do not receive enough water demand to scour the pipe surface or maintain chlorine residual. Unfortunately, discharging large volumes of chlorinated water may have adverse effects on property owners and the environment.

Flushing occurs when new facilities are installed as well as on a routine basis to maintain existing facilities. Flushing disinfected water from treatment, storage, and distribution facilities may have serious consequences on the environment receiving the discharged chlorinated water.

Moderate levels of chlorine in streams and lakes can be detrimental to aquatic life.

Missouri Regulation 10 CSR 20-2.010(22) defines a discharge as the causing or permitting one or more water contaminants to enter waters of the state. Chlorine has specific limits for discharge into water of the state (10 CSR 20-7.031 Table A). A typical maximum concentration of chlorine that may be discharged to waters of the state is 0.02 milligrams per liter (mg/l). Specific limits for chlorine discharges should be provided by the Missouri Department of Natural Resources Water Protection Program.

It is important for public water systems to know that discharging contaminant to water of the state is a violation of Missouri regulations and may result in fish kills. Although flushing procedures do not require a permit from the department, fish kills are enforceable offences that may be pursued by the department's Water Protection Program. Therefore, system operators and contractors discharging chlorinated water must consider the receiving environment.

Please understand that very few discharges from routine water main flushes require dechlorination when best management practices are used as referenced in item number two below. The following items should be considered when discharging chlorinated water:

1. If disposing of heavily chlorinated water, inspect the environment to which the water will be discharged in accordance with American Water Works Association (AWWA) Standard C651-99, Sec. 4.5.2. "Disposing of Heavily Chlorinated Water."
2. Determine the impact of the discharge to the environment. If the water to be discharged has low levels of chlorine and will not reach the waters of the state, dechlorination may not be necessary.
3. If it is determined to be necessary, dechlorinate in accordance with AWWA Standard C652 Disinfection of Water Storage Facilities Appendix B or as prescribed by your operations professional.
4. Avoid over chlorinated or over applying disinfectants when disinfection. AWWA Standard C651 Disinfecting Water Mains Appendix B contains recommended amounts of chemicals to produce various chlorine concentrations.

5. Contractors need to follow the best management practices for discharging chlorinated water and the applicable flushing procedures established by the public water supply.
6. Flushing procedures and dechlorination must be considered during the design of large water mains and storage facilities.
7. Develop a water main flushing program and maintain a flushing manual for the public water supply. Identify the necessary equipment, chemicals, and retention tanks needed for routine flushing procedures within this manual.
8. If possible, spray the interior of the tanks with a chlorine solution to reduce the volume of water to dechlorinate.
9. When possible, divert flush water from storm drains and ditches. If flush water is to enter a combined sewer, the receiving wastewater treatment facilities must be considered.
10. Avoid personal property damage, which includes flooding basement and yards to washing out lawns and flower beds.
11. Be aware of possible ice hazards on streets, sidewalks, and driveways when flushing during winter months.

It is important to remember that each flushing scenario is unique because of three factors. The first factor is the volume of water to be discharged. The second factor is the amount of disinfectant in the water to be discharged. And the final factor is the downstream environment that may be affected. It is the responsibility of each public water supply to prevent contamination of the waters of the state and to protect not only public health and our water systems but also our environment.

1. Check with local sewer department for conditions of disposal to sanitary sewer and with the state regulatory agency for conditions of disposal to natural drainage courses.
2. Chlorine residual of disposed water will be neutralized by treating with one of the chemicals listed in Appendix Table B.

This appendix is for information only and is not a part of AWWA C652.

Table B. Amounts of chemicals required to neutralize various residual chlorine concentrations in 100,000 gal (378.5 m ³) of water										
Residual Chlorine Level	Chemical Required									
	Sulfur Dioxide (SO ₂)		Sodium Bisulfite (NaHSO ₃)		Sodium Sulfite (Na ₂ SO ₃)		Sodium Thiosulfate (Na ₂ S ₂ O ₃ ·5H ₂ O)		Ascorbic Acid** (Vitamin C)	
	mg/L	lb.	(kg)	lb.	(kg)	lb.	(kg)	lb.	(kg)	(kg)
1		0.8	(0.36)	1.2	(0.54)	1.4	(0.64)	1.2	(0.54)	1.8 (0.82)
2		1.7	(0.77)	2.5	(1.13)	2.9	(1.32)	2.4	(1.09)	3.86 (1.75)
10		8.3	(3.76)	12.5	(5.67)	14.6	(6.62)	12.0	(5.44)	19 (8.5)
50		41.7	(18.91)	62.6	(28.39)	73.0	(33.11)	60.0	(27.22)	95 (43)

** Values for Ascorbic Acid are calculated, and were not field tested.